Size limit analysis of reef fishes at Ka‘ūpūlehu Marine Reserve

Erin Ristig[1] & William J Harford[2]

[1]Bren School of Environmental Science and Management,
University of California, Santa Barbara, CA 93106

[2]Nature Analytics
551 Lakeshore Rd E, Suite 105
Mississauga, Ontario, L5G 0A8

October 12, 2020

Report prepared for the Nature Conservancy and for

Ka‘ūpūlehu Marine Life Advisory Committee

Executive summary

This report contains an analysis of size limit options for 33 reef-associated fish species that was conducted in support of continued development of management measures at Kaʻūpūlehu Marine Reserve, Hawaiʻi Island. This work is provided for consideration by Kaʻūpūlehu Marine Life Advisory Committee (KMLAC) in support of development of a long-term sustainable fishery at Kaʻūpūlehu and Kūkiʻo on Hawaiʻi Island. Through a previous series of workshops coordinated by KMLAC and The Nature Conservancy, size limits were identified as one of several priority management options.

In this report, the effects of species-specific size limits are analyzed in terms of optimization of fishing yield and protection of spawning biomass. This analysis is constructed from the perspective that reaching spawning size prior to becoming vulnerable to fishing is a relevant consideration for ensuring long-term sustainability of fish populations. Thus, size limit options are explored relative to size at maturity. Accordingly, the analysis is intended to guide decision-making in relation to yield and spawning biomass objectives, and to support on-going community-led discussions about preference, feasibility, and pragmatism of size limits as management measures within the Kaʻūpūlehu Comprehensive Management Plan.

Three major takeaways addressed in this report are as follows. First, the effectiveness of a given size limit in meeting fishing yield and spawning biomass objectives is notably also a function of fishing mortality rate. Thus, size limit regulation, while sensibly considered in relation to size at maturity, should not ignore the effect of other management measures on fishing mortality rate, such as bag limits or limited access. Second, minimum size limits that offer protection of spawning biomass at an often-referenced sustainability reference point (i.e., spawning potential ratio of 30%) are achievable using size limits of 1.1 to 1.3 times the size at

maturity. This finding is especially relevant under high fishing mortality rates, although some species in our analysis differed from this finding and required larger size limits to achieve this reference point. Third, the analysis focuses on *minimum* size limits. However, some species (i.e. hermaphroditic species) will require additional care in developing suitable management measures, and such considerations are highlighted in the discussion of this study.

Table of contents

Section 1: Introduction

Ka‘ūpūlehu Marine Life Advisory Committee (KMLAC) and The Nature Conservancy (TNC) have conducted a series of workshops out of a shared motivation to achieve long-term fishery sustainability at Ka‘ūpūlehu and Kūki‘o on Hawai‘i Island (TNC/KMLAC 2020). Through these workshops, community leaders, scientists, fishermen, natural resource managers, educators, cultural practitioners, members of fisheries-focused NGOs, and staff of the Hawai‘i Division of Aquatic Resources (DAR) and Office of Hawaiian Affairs (OHA) have worked towards identification of monitoring, assessment, and management measures for Ka‘ūpūlehu Marine Reserve. A principal motivation for development of a comprehensive management plan is the need to develop a post-try-wait regulatory framework. In 2016, the State of Hawai‘i approved a ten-year designation of the Ka‘ūpūlehu Marine Reserve (KMR) following decades of work by KMLAC and its partners (TNC/KMLAC 2020). Within the 3.6-mile stretch of coastline known as KMR, nearshore fishing is not permitted during this 10-year period. This 10-year fishing ban is known as the try-wait period. Prior to the expiration of the try-wait period, the State of Hawai‘i must develop a fisheries management plan.

In partnership with TNC and KMLAC, a previous report, “Preliminary evaluation of management options for surgeonfish fisheries for Ka‘ūpūlehu marine reserve,” evaluated management strategies that were identified during KMLAC-led workshops (Harford 2020). Presentation of preliminary management options helped workshop participants to further refine priorities for management measure options. Size limits were one such option, identified by workshop participants, that required additional research (TNC/KMLAC 2020). Harford (2020) recommended that minimum size limits could be more thoroughly explored using a yield-per-recruit analysis for a compendium of Hawaiian reef fishes.

The following report presents a synthesis of the current knowledge base of life history of 33 reef-associated Hawaiian fish species and a yield-per-recruit analysis that evaluates the tradeoffs between spawning biomass and fishing yield offered by varying size limit options. This analysis is constructed from the perspective that reaching spawning size prior to becoming vulnerable to fishing is a relevant consideration for ensuring long-term sustainability of fish populations (Prince & Hordyk 2019). Thus, size limit options are explored relative to size at maturity. Accordingly, the analysis is intended to guide decision-making in terms of satisfying yield and spawning biomass objectives, and to continue to support on-going community-led discussions about preference, feasibility, and pragmatism of size limits as management measures within the Ka‘ūpūlehu Comprehensive Management Plan. The remainder of this report is structured as follows. In Section 2, detailed description of the methods and results of the analysis are provided, as well as discussion and recommendations for practical incorporation of this analysis into the comprehensive fishery management plan for KMR. Appendix 1, details the analysis results for all 33 species.

Section 2: Size Limit Analysis

Background

Size limits are a fishery management option that places a minimum and/or maximum length at capture allowed for a given species. By preventing certain sizes from being captured, size limits can protect species during specific segments of their life history. Minimum size limits set at or above length at maturity allow individuals to spawn before becoming susceptible to fishing. Maximum size limits can protect the largest individuals of a given species. Larger fish tend to be more sexually productive, contributing offspring to the population at a higher rate, and

maximum size limits can also help prevent size truncation across a population (Gwinn et al. 2015). A protected slot limit specifies a size range (both minimum and maximum) that prohibits take within the interval. Alternatively, harvestable slot limits define an interval within which take may occur. Size limits can also be set based on cultural and social norms and preferences of fishers. Size selectivity is a management option that many recreational fishers are familiar with.

This analysis focuses specifically on *minimum* size limits and provides scientific advice to inform size limit discussions within KMLAC. The analysis specifically identifies tradeoffs between maximizing fishing yield and ensuring population replenishment between different size limit options. The size limit analysis identifies options that can both protect the species, by achieving higher biomass in the long-term, while continuing to provide *pretty good yield* (Hilborn 2010). The effectiveness of a given size limit in meeting fishing yield and spawning biomass objectives is notably also a function of fishing pressure. Thus, size limit regulation is explored using different scenarios about the possible intensity of fishing mortality rate. This approach places size limit discussions into context along with other management measures that may control fishing mortality rate, such as bag limits or limited access. Accordingly, the analysis is intended to guide size limit decision-making in relation to yield and spawning biomass objectives in conjunction with considerations about other management measures and community preferences and feasibility. The tradeoffs of the differing size limit options are summarized as general patters across species in the main text and are laid out for each species in detail in Appendix 1.

Methods

The yield-per-recruit analysis was conducted for 33 species. Certain life history parameters are necessary to complete the analysis for a given species. These parameters are: the von Bertalanffy growth parameters – Linfinity (mean maximum length), K (growth coefficient), t0 (theoretical age at zero length); Lm (length at which 50% of individuals are mature); tmax (maximum observed age, based on life history study samples); LW-a and LW-b (length to weight ratios). All species included in the analysis had the required life history data. In compiling life history parameter data, most parameter values were obtained from MS Access database managed by NOAA Pacific Islands Fishery Science Center (PIFSC). An additional supplemental literature review was conducted to identify life history studies that had been published more recently. Where multiple estimates of life history parameters were available for a given species, studies conducted surrounding the main Hawaiian Islands were given priority because these studies were closest in geographic proximity to Hawai‘i Island. Winston et al. 2017 identified the possibility of latitudinal growth variation of reef fishes, thus our selection of life history parameters focused on life history studies closest in proximity to Hawai‘i Island. Selection of life history parameters was also prioritized to data from recent, in-depth studies, including as necessary from locations outside of Hawai‘i. The supplemental literature review utilized studies from Demartini & Howard (2016), Demartini et al (2018), Donovan et al (2015), Kulbicki et al (2005), Nadon et al (2020), Schemmel & Friedlander (2016), and Winston et al (2017).

For species whose life history parameters do not differ, or differ only slightly, between male and female, the female parameters were used in the analysis by default. Also, in studies where male and female growth or maturity were not reported as sex-specific parameter estimates,

these single-sex life history parameters were used in this study. The steps taken in selecting life history parameters are consistent with those reflected in development of the PIFSC database.

Exceptions to the above steps in life history specification were made for several species of protogynous hermaphrodites and where growth curves differed considerably between males or females or between results from comparable field studies. Six species in the analysis are protogynous hermaphrodites (*Chlorurus perspicillatus*, *Chlorurus sordidus*, *Chlorurus spilurus*, *Scarus psittacus*, *Scarus rubroviolaceus*, and *Cephalopholis argus*), maturing first as females and later becoming males. For these hermaphroditic species, the analysis was conducted for female length at maturity, however, the male portion of the life history is discussed as an additional management consideration within the Recommendations section of this report. For the species *Naso unicornis*, length at 50% maturity differed substantially between male and female, so both sexes are analyzed separately. In the case of *Ctenochaetus strigosus*, local studies had notably different life history parameters, so parameters from both studies were analyzed separately.

Parameters pertaining to fish length are in Fork Length (FL). Size limit options are also specified as FL. In many instances, life history parameters (e.g., Lm and Linfinity) were originally reported in length measurements other than FL. For species that had measurements in Total Length (TL) or Standard Length (SL), conversion factors were used to convert to FL.

Instantaneous natural mortality rate (M) was calculated using the formula ln(0.04)/tmax (Then et al. 2015). The rationale for this estimator, as it has specifically been applied to Hawai‘i reef fish, comes from Nadon et al. (2015). For *Acanthurus triostegus sandvicensis*, for which longevity (tmax) data was not available, the following formula was used instead (Then et al. 2015): (4.118*(K)^0.73)*(Linfinity^-0.33).

The yield-per-recruit analysis was conducted in the R statistical computing environment using the Length-Based Spawning Potential Ratio (LBSPR) R package, specifically, the Length-Structured Growth-Type-Group Model (R Development Core Team 2020; Hordyk et al. 2015; Hordyk et al. 2016). The LBSPR R package contains both a fitting routine that estimates the state of the fishery based on observed length structure of the catch as well as a simulation tool for yield-per-recruit analysis. The simulation tool was applied to the question of size limit options, using the life history parameters described above as inputs. LBSPR requires specification of stock-recruitment steepness, which for yield-per-recruit analysis was set to 0.99. In addition, LBSPR requires maturity to be specified as a logistic function (requiring Lm and length at which 95% mature (L95) as model inputs). In the absence of logistic maturity functions for all the species considered in this study, L95 was set to Lm plus one. In LBSPR, size limits are specified by modifying the selectivity function used in the simulation tool. Selectivity is specified as a logistic function, with parameters SL50 and SL95. Size limit options (SL50) were specified as a multiplier of Lm. For each SL50 option, SL95 is accordingly specified as SL50 plus one, which approximates knife-edge selectivity. As analysis across all species was carried out through batch processing, some additional restrictions were specified. For species that mature close to Linf some size limits (set as multipliers of Lm) would create size limits greater than Linf. In these cases, only multipliers that led to size limits less than 0.95xLinf are included in the analysis.

The combined effects of minimum size limit and fishing pressure were calculated using two metrics: relative yield and spawning potential ratio (SPR). Relative yield converts yield in biomass per recruit to a relative measure on a scale of zero to one. A value of one indicates the combination of size limit and fishing mortality rate that produces optimal yield. Values less than one are proportions of optimal yield, thus enabling consideration of whether relative yield for a

given management measure can be considered *pretty good* or satisfactory, given other management considerations. SPR is a measure of the state of reproductive potential of the stock and a proxy for spawning biomass (Goodyear 1993). In the complete absence of fishing, SPR is 100% and SPR value decreases as fishing pressure increases, with an SPR of 0% indicating a population with no spawning.

The combined effects of minimum size limit and fishing pressure on relative yield and SPR were evaluated using two approaches. In the first approach, factorial combinations of size limit options and fishing mortality levels were specified. The approach provides an 'at a glance' comparison of size limit options. Size limit options specified as multipliers of species-specific Lm were 0.9, 1.0, 1.1, 1.2, 1.3, 1.5, and 2.0. The LBSPR approach requires fishing pressure to be specified as a ratio of F/M, where F is the instantaneous fishing mortality rate. This is a useful approach because it enables direct comparison of fishing pressures between species. Fishing pressure was specified as low (Low; F/M = 1), medium (Med; F/M = 2), and high (High; F/M = 4). These levels of fishing pressure were selected by examining the relationships between F/M and SPR across all species included in this study (Fig. 1). For most species, F/M = 4 reduced SPR to less than 0.2, and thus, this level was considered as high fishing pressure. SPR was reduced below 0.4 for most species when F/M = 2, and SPR was reduced below 0.6 for most species when F/M = 1. These calculations were made under the assumption that the minimum size limit for each species corresponded to its Lm.

In the second approach, relative yield and SPR were calculated over sequences of F/M and minimum size limit. F/M was specified in discrete steps of 0.1, from 0 to 4. Minimum size limits were specific in 5 mm steps between 0.1 x Lm and 0.95 x Linfinity for each species. This approach allowed useful visualizations of over a wider range of size limit options, including

contour plots and Pareto efficiency surfaces that highlight trade-offs between yield (relative yield) and reproductive potential (SPR). This approach was also the basis for identifying species-specific optimal yield, which was a necessary quantity in calculating relative yield on a scale from zero to one.

Results

Given that minimum size limits were examined in relation to length at maturity (Lm), Table 1 shows Lm and asymptotic size (Linfinity) used in analysis for each species and the current DAR minimum size limit regulations (as applicable). Figure 1 plots SPR and YPR values against fishing pressure for all 33 reef-associated fishes. As can be seen on the left-hand plot, as fishing pressure increases, SPR decreases – meaning the more fishing taking place the greater the decrease in reproductive potential. Conversely, the right-hand plot demonstrates that as fishing pressure increases, YPR increases, up to a certain point. Table 2 serves as a general guide to considering size limits relative to Lm. For each species, a minimum size limit was identified that offers protection of spawning biomass at a sustainability reference point of SPR $\geq$ 0.3. This minimum size estimate was made at low, med, and high fishing pressures, which highlights that larger size limits are typically required under higher fishing pressures to achieve the same level of spawning biomass protection (i.e., SPR $\geq$ 0.3; Fig. 2).

Under the circumstance of high fishing pressure, minimum size limits of 1.1 to 1.3 times the size at maturity tend to achieve SPR $\geq$ 0.3 (Table 2). Although, some species differed from this finding and required larger minimum size limits (typically 1.5xLm, or fishing pressure below F/M = 4) to achieve this reference point. These species include *Ctenochaetus strigosus*, *Naso unicornis* (male), *Caranx ignobilis*, *Caranx melampygus*, *Mugil cephalus*, *Mulloidichthys*

flavolineatus, *Parupeneus porphyreus*, *Chlorurus spilurus*, *Scarus Psittacus* (Table 2). Additionally, two species, *Pseudocaranx dentex* and *Parupeneus multifasciatus* (size limit labeled 'other' in Table 2) mature at very early ages relative to all other species that were considered. These two species likely require minimum size limits of approximately 1.5xLm and avoidance of high fishing pressure to be managed sustainably. Multipliers of species-specific Lm needed to achieve the same level of spawning biomass protection across species varied as a function of life history characteristics (Fig. 3). Most notably, a trend exists in increasing of the multiplier value with increasing M/K ratio and decreasing multiplier value with increasing Lm/Linfinity.

Appendix 1 provides detailed yield-per-recruit analysis for each species. The tables and figures in the appendix are described here to assist the reader in their interpretation. Tables in the appendix show the relative yield and SPR that result from combinations of fishing pressure (i.e., levels of low, med, or high) and minimum size limits specified as multipliers of Lm. For example, many species in the appendix show a pattern that high fishing pressure (F/M) paired with a minimum size limit between 1.1 and 1.3 times Lm, produces high relative yield. Likewise, this same scenario produces SPR $\geq$ 0.3. In simple terms, this demonstrates that over the long term, fishers capturing a large amount of fish, with sufficient conservation (via a size limit) to maintain reproductive potential, will produce yield while supporting long-term resource sustainability.

Appendix 1 also contains two type of plots: contour plots and Pareto efficiency surfaces. Contour plots are created for relative yield and SPR, for a large range of minimum size limits (y-axis) and fishing pressures (F/M; x-axis). An example of these plots in shown in Figure 4 of the main text, with annotations to assist readers in interpretation. These contour plots are particularly

useful for identifying a size limit that produces satisfactory relative yields across a range of F/M, since F/M is often more difficult to control in recreational fisheries. Pareto plots are another means of highlighting the trade-off between attaining high yield and ensuring continued reproductive potential. The Pareto plot directly compares SPR (y-axis) and relative yield (x-axis) for alternative management options (points on the plot). Readers will note that no point on the plot maximizes both SPR and relative yield. Instead, a trade-off between management options is evident. From a conservation perspective, some options maximize SPR better than others. From a fishery perspective, some options maximize relative yield better than others. Color coding of points is important. The black points on the plot represent combinations where minimum size limit is equal to species' length at maturity. Green points represent minimum size limits greater than length at maturity and red points represent minimum size limits less than length at maturity. For most species in the appendix, the most "efficient" combinations, that seek to maximize both SPR *and* relative yield are found on the far-right edge or "frontier" of the plot.

Discussion

This study supports two main conclusions. First, the effectiveness of a given size limit in meeting fishing yield and spawning biomass objectives is notably also a function of fishing mortality rate. Thus, size limit regulation, while sensibly considered in relation to size at maturity, should not ignore the effect of other management measures on fishing mortality rate, such as bag limits or limited access. Second, minimum size limits that offer protection of spawning biomass at an often-referenced sustainability reference point (i.e., spawning potential ratio of 30%) are achievable using size limits of 1.1 to 1.3 times the size at maturity. This finding is especially relevant under high fishing mortality rates, although some species in our analysis

differed from this finding and may require larger size limits. SPR of 30% was selected because this reference point has been previously used as a biological limit in State-wide stock assessment and because calculating Lm multipliers relative to a single reference point facilitated comparisons across life histories (Nadon 2017). While SPR 30% was chosen as a reference point in this study, it should be noted that SPR-based fisheries management targets are routinely set above this value, often in the range of 35% to 50% depending on life history and prevailing environmental conditions (Hordyk et al. 2015).

As noted previously, six species in the analysis are protogynous hermaphrodites (*Chlorurus perspicillat*us, *Chlorurus sordidus*, *Chlorurus spilurus*, *Scarus psittacus*, *Scarus rubroviolaceus*, and *Cephalopholis argus*). For these hermaphroditic species, the minimum size analysis was conducted for female length at maturity. Given that these species first reach maturity as female and at a later point in their life history become sex-changed males, protecting the male phase of the life history is also important for the overall population health. For those species of the family Scaridae (parrotfish), one management option would be to apply a minimum size limit to protect female maturity while also implementing a regulation that prohibits the take of blue- and green-colored terminal-phase (TP) parrotfish. Colorful and large TP males are common for most species of protogynous sequential hermaphroditic parrotfishes (Demartini et al. 2018). Such a regulation could prevent overfishing of sex-changed TP males, specifically *Chlorurus perspicillatus*, *Chlorurus carolinusat*, and *Scarus rubroviolaceus*, while offering extra protection for *Chlorurus spilurus* and *Scarus psittacus* at a minimal cost (Demartini & Howard 2016). While the LBSPR method does not specifically accommodate sex change in calculation of relative yield and SPR, alternative modeling frameworks have been described that could be applied to Hawaiian species (Brooks et al. 2008; Punt et al. 1993).

The yield-per-recruit analysis of this report specifically addresses *minimum* size limits. Slot limits are another management option KMLAC could consider to be more thoroughly explored in future research. Given that larger fish of a given species tend to produce more eggs and replenish the population at a higher rate, slot limits can help ensure that these larger fish are also protected (Barneche et al. 2018). Additionally, since fishers, especially recreational fishers, often target larger, "trophy" catches, slot limits can help prevent size truncation across a population as a result of this preference (Gwinn et al. 2015). Some research has shown that slot limits can oftentimes outperform minimum size limits for optimizing both biomass and yield (Ahrens et al. 2020).

When it comes to practical implementation of size limits as a management tool for Kaʻūpūlehu Marine Reserve, considerations include selection of size limits, current regulations, and simplicity. Based on assumptions and uncertainties inherent in the analysis, erring on the side of higher minimum size limits is recommended to ensure sustained population health. The life history parameters used for this analysis come from a range of studies, a few of which are Hawaiʻi island specific, but the majority of which are averaged across Hawaiian islands or Oʻahu specifically. Fish population and growth can differ between islands, and in the case that fish in the North Kona area are slightly larger than populations at other islands, a higher size limit would buffer against this margin of error (Winston et al. 2017).

Division of Aquatic Resources (DAR) regulations have specified minimum size limits for 18 of the 33 species in this analysis (Table 1; DAR 2019). There are species for which this analysis shows that the state size limit allows for capture of juveniles. Ensuring that minimum size limits are at or above length at maturity is recommended, and for species for which this is not the case, alternatives could be considered. Furthermore, minimum size limits for Kaʻūpūlehu

Marine Reserve that differ from state regulations, for 33 different species, may require practical consideration from an implementation or enforcement perspective. It is also advisable to consider examining which are the most commonly caught species based on Ka‘ūpūlehu creel data. A focus on implementing minimum size limits for species that have historically been heavily fished, or for species that hold cultural or social significance, may help prioritize species for which size limits are more critical. Finally, in this analysis the effects of varying size limits are considered in conjunction with fishing effort. Other management strategies that have an effect on fishing pressure, such as bag limits, limited access, and gear restrictions, will play into the overall effectiveness of size limit regulations.

Acknowledgements

WJH & ER thank The Nature Conservancy (TNC), Ka‘ūpūlehu Marine Life Advisory Committee, and Hawai‘i Division of Aquatic Resources for their leadership and engagement in this work. WJH & ER thank the following TNC staff for their guidance and technical support in conducting this work: E. Conklin, R. Most, J. Wilson, R. Lee. This work was also improved through thoughtful discussions with P. Moore, M. Nadon, A. Friedlander, and E. Schemmel.

References

Ahrens, R. N. M., M. S. Allen, C. Walters, and R. Arlinghaus. 2020. Saving large fish through harvest slots outperforms the classical minimum-length limit when the aim is to achieve multiple harvest and catch-related fisheries objectives. Fish and Fisheries. *21*(3): 483-510.

Barneche, D. R., D. R. Robertson, C. R. White, D. J. Marshall. 2018. Fish reproductive-energy

output increases disproportionately with body size. Science. 360(6389): 642-645.

Brooks, E.N., Shertzer, K.W., Gedamke, T., and Vaughan, D.S. 2008. Stock assessment of protogynous fish: evaluating measures of spawning biomass used to estimate biological reference points. Fish Bull. **106**(1): 12.

(DAR) Division of Aquatic Resources. 2019. Hawai‘i Fishing Regulations. Department of Land and Natural Resources, Division of Aquatic Resources, State of Hawai‘i. Retrieved from: https://dlnr.hawaii.gov/dar/files/2019/06/fishing_regs_Jul_2019.pdf.

Demartini, E. E., A. H. Andrews, K. G. Howard, B. M. Taylor, D. Lou, and M. K. Donovan. 2018. Comparative growth, age at maturity and sex change, and longevity of Hawaiian parrotfishes, with bomb radiocarbon validation. Can. J. Fish. Aquat. Sci. 75: 580–589.

Demartini, E. E. and K. G. Howard. 2016. Comparisons of body sizes at sexual maturity and at sex change in the parrotfishes of Hawai‘i: input needed for management regulations and stock assessments. Journal of Fish Biology. 88: 523-541.

Donovan, M. K., A. M. Friedlander, K. K. Harding, E. M. Schemmel, A. Filous, K. Kamikawa, and N. Torkelson. 2015. Ecology and niche specialization of two bonefish species in Hawai‘i. Environmental Biology of Fishes. 98: 2159-2171.

Goodyear, C.P. 1993. Spawning stock biomass per recruit in fisheries management: foundations and current use. *In* Risk evaluation and biological reference points for fisheries management. *Edited by* S.J. Smith and J.J. Hunt. Special Publication in Fisheries and Aquatic Sciences, 120, Canada.

Gwinn, D. C., M. S. Allen, F. D. Johnston, P. Brown, C. R. Todd, and R. Arlinghaus. 2015. Rethinking length-based fisheries regulations: the value of protecting old and large fish with harvest slots. Fish and Fisheries. *16*(2): 259–281.

Harford, W.J. 2020. Preliminary evaluation of management options for surgeonfish fisheries for Ka‘ūpūlehu marine reserve. Report prepared for Ka‘ūpūlehu Marine Life Advisory Committee and The Nature Conservancy.

Hilborn, R. 2010. Pretty good yield and exploited fisheries. Mar. Policy 34: 193–196.

Hordyk, A., K. Ono, S. Valencia, N. Loneragan, and J. Prince. 2015. A novel length-based empirical estimation method of spawning potential ratio (SPR), and tests of its performance, for small-scale, data-poor fisheries. ICES J. Mar. Sci. **72**: 217-231. doi:10.1093/icesjms/fsu004.

Hordyk, A.R., Ono, K., Prince, J.D., and Walters, C.J. 2016. A simple length-structured model based on life history ratios and incorporating size-dependent selectivity: application to spawning potential ratios for data-poor stocks. Can. J. Fish. Aquat. Sci. **73**(12): 1787-1799. doi:10.1139/cjfas-2015-0422.

Kulbicki, M., N. Guillemot, and M. Amand. 2005. A general approach to length-weight relationships for New Caledonian lagoon fishes. Cybium. **29**(3): 235-252.

Langston, R., K. Longenecker, and J. Claisse. 2009. Growth, mortality and reproduction of kole, *Ctenochaetus strigosus.* Final Report. Prepared for Fisheries Local Action Strategy and Division of Aquatic Resources.

Nadon, M. O., J. S. Ault, I. D. Williams, S. G. Smith, and G. T. DiNardo. 2015. Length-Based Assessment of Coral Reef Fish Populations in the Main and Northwestern Hawaiian Islands. PLOS ONE 10:e0133960.

Nadon, M. O. 2017. Stock assessment of the coral reef fishes of Hawai‘i, 2016. NOAA Technical Memorandum NMFS-PIFSC-60.

Nadon, M. O., M. Sculley, and F. Carvalho. 2020. Stock Assessment of Uku (Aprion virescens)

in Hawaii, 2020. NOAA Technical Memorandum NMFS-PIFSC-100.

Prince, J. and A. Hordyk. 2019. What to do when you have almost nothing: A simple quantitative prescription for managing extremely data-poor fisheries. Fish and Fisheries. 20: 224-238.

Punt, A.E., Garratt, P.A., and Govender, A. 1993. On an approach for applying per-recruit methods to a protogynous hermaphrodite, with an illustration for the slinger Chrysoblephus puniceus (Pisces: Sparidae). South African Journal of Marine Science **13**(1): 109–119. doi:10.2989/025776193784287293.

R Development Core Team. 2020. R: A Language and Environment for Statistical Computing, Vienna, Austria http://www.R-project.org. Vienna, Austria.

Schemmel, E. M. and A. M. Friedlander. 2016. Participatory fishery monitoring is successful for understanding the reproductive biology needed for local fisheries management. Environmental Biology of Fishes. 100: 171-185.

Then, A. Y., J. M. Hoenig, N. G. Hall, and D. A. Hewitt. 2015. Evaluating the predictive performance of empirical estimators of natural mortality rate using information on over 200 fish species. ICES J. Mar. Sci. 72(1):82-92.

TNC/KMLAC. 2020. FishPath Workshop 3 Report. Kaʻūpūlehu Marine Life Advisory Committee and The Nature Conservancy, Kaʻūpūlehu Interpretive Center at Kalaemanō. January 21-22, 2020.

Winston, M. S., B. M. Taylor, and E. C. Franklin. 2017. Intraspecific variability in the life histories of endemic coral-reef fishes between photic and mesophotic depths across the Central Pacific Ocean. Coral Reefs. 36:663–674.

Kaʻūpūlehu Species

Hawaiian Name	Common Name	Scientific Name	Length at maturity (in)	Mean asymptotic length (Loo; in)	DAR minimum size limit (in)
Pualu	Ringtail Surgeonfish	Acanthurus blochii***	10	13	
Palani	Eyestriped Surgeonfish	Acanthurus dussumieri***	11	15	
Manini	Convict Tang	Acanthurus triostegus sandvicensis***	6	7	5
Pualu	Yellowfin Surgeonfish	Acanthurus xanthopterus	17	20	
Kole	Goldring Surgeonfish	Ctenochaetus strigosus***	3	7	
Kala Lolo	Paletail Unicornfish	Naso brevirostris	11	13	14
ʻŌpelu kala	Sleek Unicornfish	Naso hexacanthus	20	24	16
Umauma lei	Orangespine Unicornfish	Naso lituratus***	8	10	
Kala	Bluespine Unicornfish	Naso unicornis***	14	19	14
ʻŌ'io	Shortjaw Bonefish	Albula glossodonta	17	26	14
ʻŌ'io	Longjaw Bonefish	Albula virgata	17	22	
Ulua aukea	Giant Trevally	Caranx ignobilis***	29	77	10
Ulua lāʻuli	Black Trevally	Caranx lugubris	15	32	10

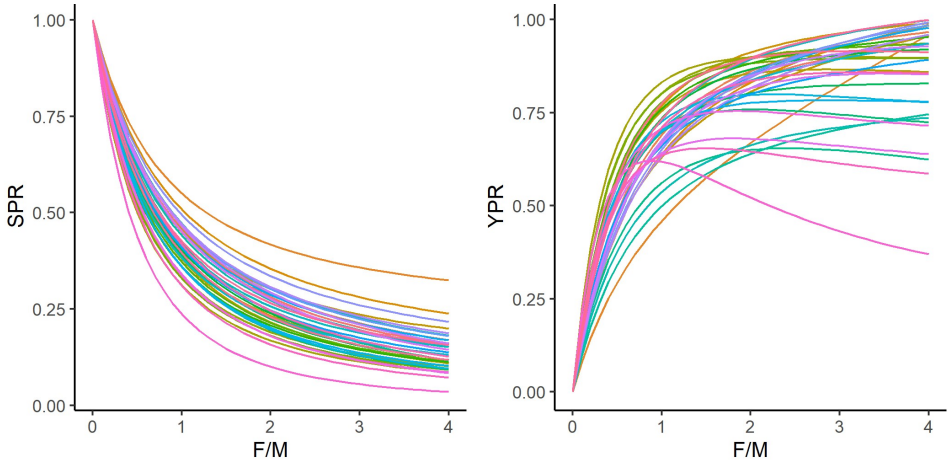
Hawaiian Name	Common Name	Scientific Name	Length at maturity (in)	Mean asymptotic length (Loo; in)	DAR minimum size limit (in)
ʻŌmilu	Bluefin Trevally	Caranx melampygus	18	40	10
Pake ulua	Bigeye Trevally	Caranx sexfasciatus	18	31	10
Kamanu	Rainbow Runner	Elagatis bipinnulata	25	37	
Butaguchi	Thick Lipped Jack	Pseudocaranx dentex	10	49	
Kahala	Greater Amberjack	Seriola dumerili	31	44	
ʻŪʻū	Bigscale Soldierfish	Myripristis berndti	6	10	
Uku	Green Jobfish	Aprion virescens	18	30	
Ta'ape	Bluestipe Snapper	Lutjanus kasmira	8	13	
Ama'ama	Striped Mullet	Mugil cephalus	12	22	11
Wekeʻā	Yellowstripe Goatfish	Mulloidichthys flavolineatus***	7	13	7
Weke 'ula	Yellowfin Goatfish	Mulloidichthys vanicolensis	7	9	
Moano	Manybar Goatfish	Parupeneus multifasciatus***	6	12	7
Kūmū	Whitesaddle Goatfish	Parupeneus porphyreus	9	19	10
Uhu-uliuli	Spectacled Parrotfish	Chlorurus perspicillatus	14	21	12

Hawaiian Name	Common Name	Scientific Name	Length at maturity (in)	Mean asymptotic length (Loo; in)	DAR minimum size limit (in)
Uhu	Bullethead Parrotfish	Chlorurus sordidus	7	12	
Uhu	Pacific Daisy Parrotfish	Chlorurus spilurus	7	14	12
Uhu	Palenose Parrotfish	Scarus psittacus	5	13	12
Uhu pālukaluka	Redlip Parrotfish	Scarus rubroviolaceus***	14	21	12
Roi	Peacock Grouper	Cephalopholis argus	11	20	
Kākū	Great Barracuda	Sphyraena barracuda	31	49	

			Minimum size limit achieving SPR 30%			Relative yield achieved					
	Length at maturity (Lm)		Fishing pressure (F/M)			Fishing pressure (F/M)					Lm option
Species	in	mm	L	M	H	L	M	H	M/K	Lm/Loo	F/M = H
Acanthurus blochii	10.12	257	231	283	308	0.67	0.81	0.89	0.37	0.76	1.2 x Lm
Acanthurus dussumieri	11.10	282	254	310	338	0.70	0.85	0.91	0.39	0.76	1.2 x Lm
Acanthurus triostegus sandvicensis	6.14	156	140	156	156	0.56	0.67	0.95	0.68	0.88	1 x Lm
Acanthurus xanthopterus	16.97	431	388	431	474	0.70	0.85	0.87	0.33	0.86	1.1 x Lm
Ctenochaetus strigosus	3.31	84	76	126	168	0.55	0.74	0.87	0.20	0.47	2 x Lm
Ctenochaetus strigosus - female	3.31	84	76	84	101	0.49	0.64	0.97	0.27	0.73	1.2 x Lm
Ctenochaetus strigosus - male	3.94	100	90	110	120	0.53	0.69	0.93	0.35	0.69	1.2 x Lm
Naso brevirostris	10.59	269	242	269	296	0.68	0.86	1.00	0.32	0.82	1.1 x Lm
Naso hexacanthus	20.12	511	460	511	562	0.71	0.84	0.83	0.33	0.85	1.1 x Lm
Naso lituratus	7.83	199	179	199	219	0.64	0.81	1.00	0.38	0.78	1.1 x Lm
Naso unicornis - male	11.85	301	271	361	452	0.66	0.85	0.88	0.14	0.63	1.5 x Lm
Naso unicornis - female	13.98	355	320	391	426	0.67	0.86	0.99	0.15	0.74	1.2 x Lm
Albula glossodonta	16.69	424	382	466	509	0.79	0.90	0.97	1.28	0.63	1.2 x Lm
Albula virgata	17.01	432	389	475	475	0.72	0.67	0.84	1.13	0.77	1.1 x Lm

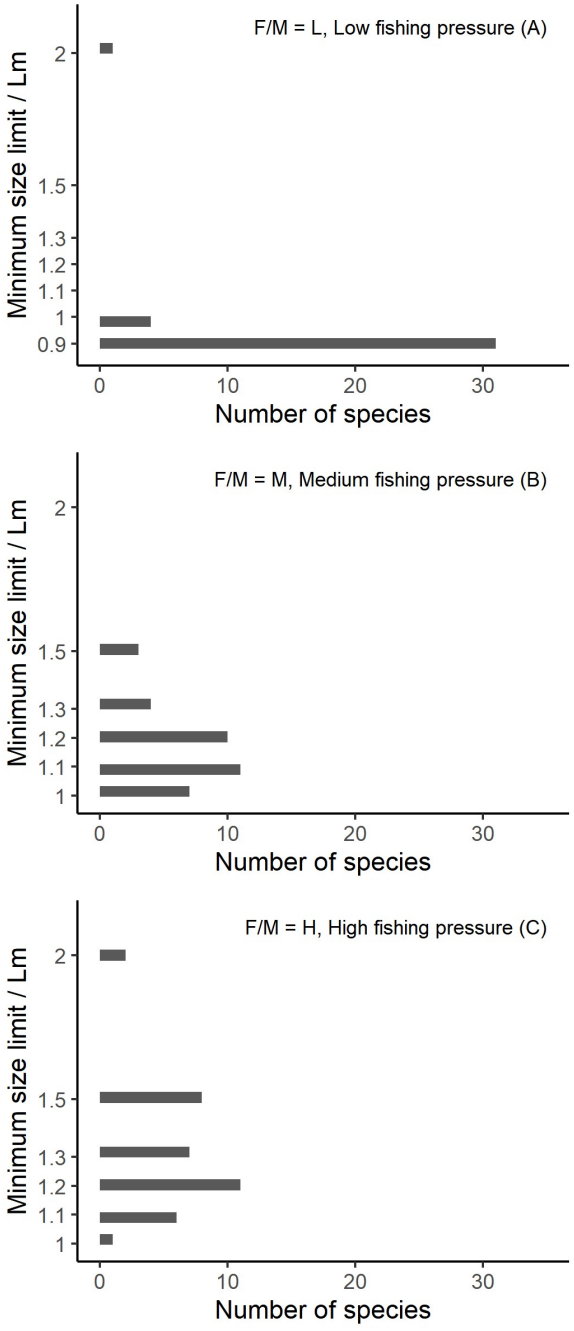
			Minimum size limit achieving SPR 30%			Relative yield achieved					
	Length at maturity (Lm)		Fishing pressure (F/M)			Fishing pressure (F/M)					Lm option
Species	in	mm	L	M	H	L	M	H	M/K	Lm/Loo	F/M = H
Caranx ignobilis	29.13	740	740	962	1110	0.83	0.92	0.95	2.64	0.38	1.5 x Lm
Caranx lugubris	14.57	370	370	444	481	0.81	0.91	1.00	2.24	0.45	1.3 x Lm
Caranx melampygus	17.80	452	452	542	678	0.80	0.91	0.90	1.97	0.45	1.5 x Lm
Caranx sexfasciatus	17.91	455	410	546	592	0.77	0.89	0.95	1.22	0.57	1.3 x Lm
Elagatis bipinnulata	25.20	640	576	704	768	0.77	0.82	0.80	1.16	0.69	1.2 x Lm
Pseudocaranx dentex	10.24	260	520			0.78			1.50	0.21	Other
Seriola dumerili	31.46	799	719	879	959	0.77	0.82	0.80	0.94	0.71	1.2 x Lm
Myripristis berndti	6.34	161	145	177	193	0.66	0.80	0.96	0.81	0.65	1.2 x Lm
Aprion virescens	17.72	450	405	540	585	0.74	0.90	1.00	0.74	0.59	1.3 x Lm
Lutjanus kasmira	7.64	194	175	213	233	0.70	0.83	0.96	1.39	0.59	1.2 x Lm
Mugil cephalus	11.65	296	266	385	444	0.71	0.89	0.98	0.83	0.53	1.5 x Lm
Mulloidichthys flavolineatus	7.20	183	165	220	274	0.68	0.85	1.00	0.95	0.54	1.5 x Lm
Mulloidichthys vanicolensis	6.89	175	158	175	193	0.69	0.87	1.00	0.50	0.77	1.1 x Lm
Parupeneus multifasciatus	5.71	145	130	218	218	0.62	0.82	0.95	0.85	0.48	1.5 x Lm
Parupeneus porphyreus	9.37	238	214	309	357	0.68	0.87	0.98	1.00	0.48	1.5 x Lm

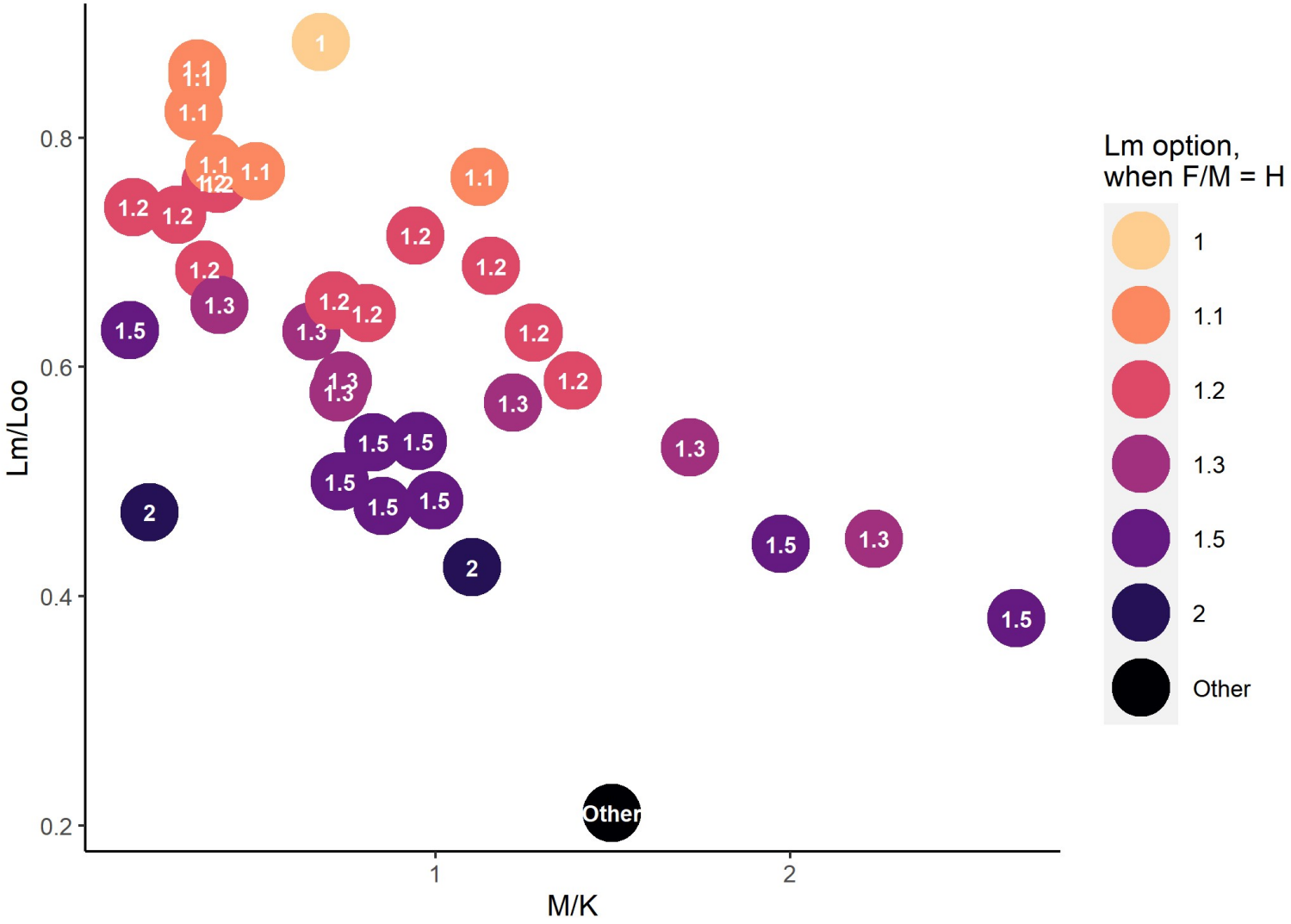
			Minimum size limit achieving SPR 30%			Relative yield achieved					
	Length at maturity (Lm)		Fishing pressure (F/M)			Fishing pressure (F/M)					Lm option
Species	in	mm	L	M	H	L	M	H	M/K	Lm/Loo	F/M = H
Chlorurus perspicillatus	13.78	350	315	385	420	0.73	0.88	1.00	0.72	0.66	1.2 x Lm
Chlorurus sordidus	6.69	170	153	204	221	0.68	0.86	1.00	0.73	0.58	1.3 x Lm
Chlorurus spilurus	6.77	172	155	224	258	0.68	0.87	1.00	0.73	0.50	1.5 x Lm
Scarus psittacus	5.47	139	139	208	278	0.64	0.83	0.83	1.10	0.43	2 x Lm
Scarus rubroviolaceus	13.78	350	315	420	455	0.70	0.88	1.00	0.39	0.65	1.3 x Lm
Cephalopholis argus	10.55	268	241	322	348	0.76	0.85	0.94	1.72	0.53	1.3 x Lm
Sphyraena barracuda	30.71	780	702	936	1014	0.77	0.91	0.98	0.65	0.63	1.3 x Lm

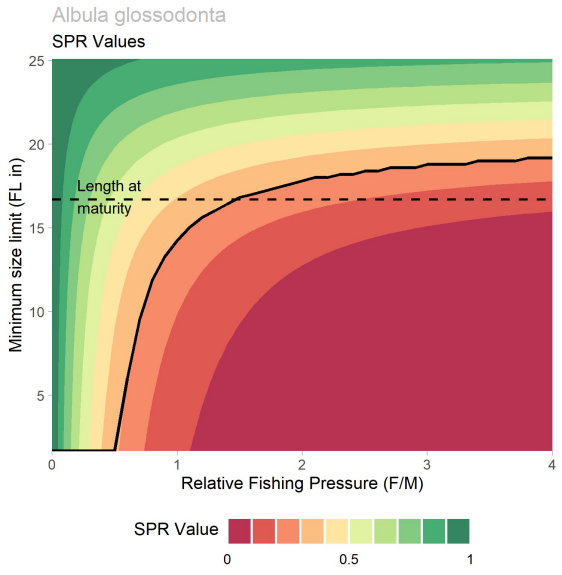


Species

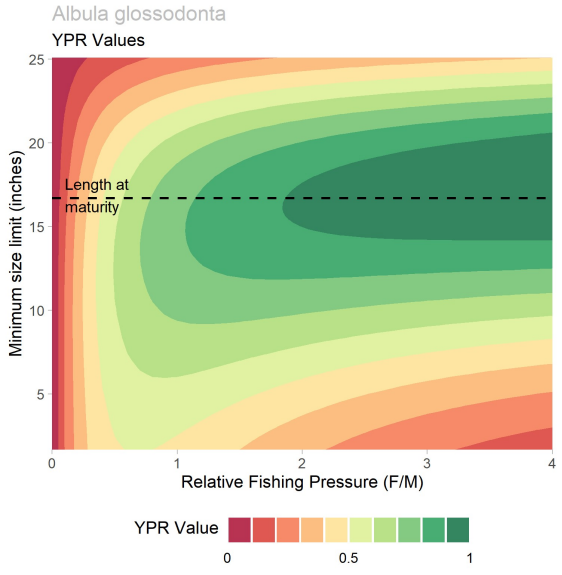
- Acanthurus blochii
- Acanthurus dussumieri
- Acanthurus triostegus sandvicensis
- Acanthurus xanthopterus
- Albula glossodonta
- Albula virgata
- Aprion virescens
- Caranx ignobilis
- Caranx lugubris
- Caranx melampygus
- Caranx sexfasciatus
- Cephalopholis argus
- Chlorurus perspicillatus
- Chlorurus sordidus
- Chlorurus spilurus
- Ctenochaetus strigosus
- Ctenochaetus strigosus - female
- Ctenochaetus strigosus - male
- Elagatis bipinnulata
- Lutjanus kasmira
- Mugil cephalus
- Mulloidichthys flavolineatus
- Mulloidichthys vanicolensis
- Myripristis berndti
- Naso brevirostris
- Naso hexacanthus
- Naso lituratus
- Naso unicornis - female
- Naso unicornis - male
- Parupeneus multifasciatus
- Parupeneus porphyreus
- Pseudocaranx dentex
- Scarus psittacus
- Scarus rubroviolaceus
- Seriola dumerili
- Sphyraena barracuda


F/M = L, Low fishing pressure (A)
Minimum size limit / Lm
2
1.5
1.3
1.2
1.1
1
0.9
0
10
20
30
Number of species
F/M = M, Medium fishing pressure (B)
Minimum size limit / Lm
2
1.5
1.3
1.2
1.1
1
0
10
20
30
Number of species
F/M = H, High fishing pressure (C)
Minimum size limit / Lm
2
1.5
1.3
1.2
1.1
1
0
10
20
30
Number of species


Lm/Loo
0.8
0.6
0.4
0.2
1
2
M/K
Other
Lm option,
when F/M = H
1
1.1
1.2
1.3
1.5
2
Other



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid li
corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Label
correspond to SPR achieved for minimum size limit - F/M combinations presented in
table above.



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels
correspond to YPR achieved for minimum size limit - F/M combinations presented in
table above.

Appendix 1

Spawning Potential Ratio and Yield per Recruit Analyses

Acanthuridae - Surgeonfishes

Species: **Acanthurus blochii**

Hawaiian Name: Pualu

Common Name: Ringtail Surgeonfish

Family: Surgeonfishes

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 338 mm FL

K (von Bertalanffy growth parameter): 0.25 per year

t0 (von Bertalanffy parameter): -0.38

Lm (Length at maturity): 257 mm FL

Lm (Length at maturity): 10 inches FL

M (natural mortality rate): 0.09 per year

Longevity: 35 years

M/K: 0.36

Lm/Loo: 0.76

Acanthurus blochii - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	231	9.1	**0.40**	**0.23**	**0.11**
1 x Lm	257	10.1	**0.45**	**0.28**	**0.16**
1.1 x Lm	283	11.1	**0.53**	**0.39**	**0.28**
1.2 x Lm	308	12.1	**0.65**	**0.53**	**0.45**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

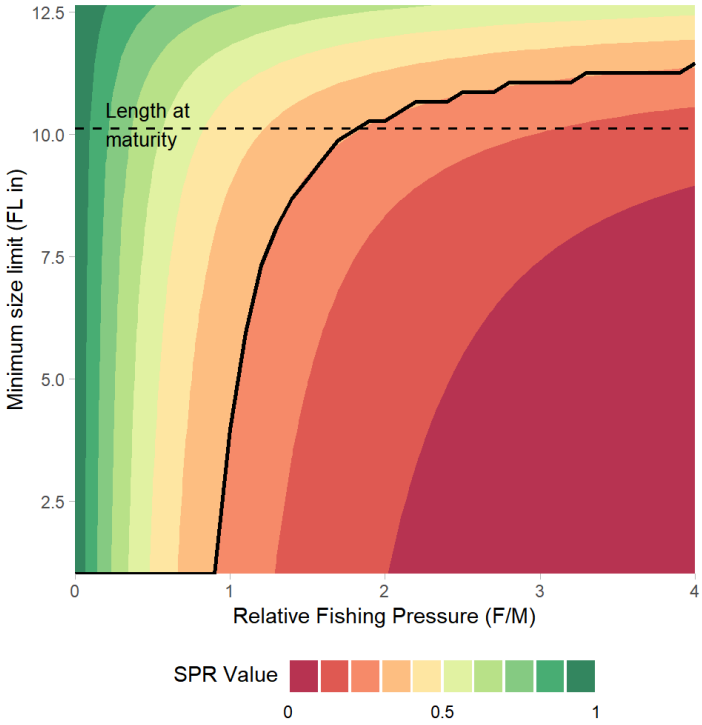
Acanthurus blochii - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	231	9.1	**0.67**	**0.81**	**0.86**
1 x Lm	257	10.1	**0.67**	**0.83**	**0.92**
1.1 x Lm	283	11.1	**0.63**	**0.81**	**0.97**
1.2 x Lm	308	12.1	**0.52**	**0.71**	**0.89**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Acanthurus blochii

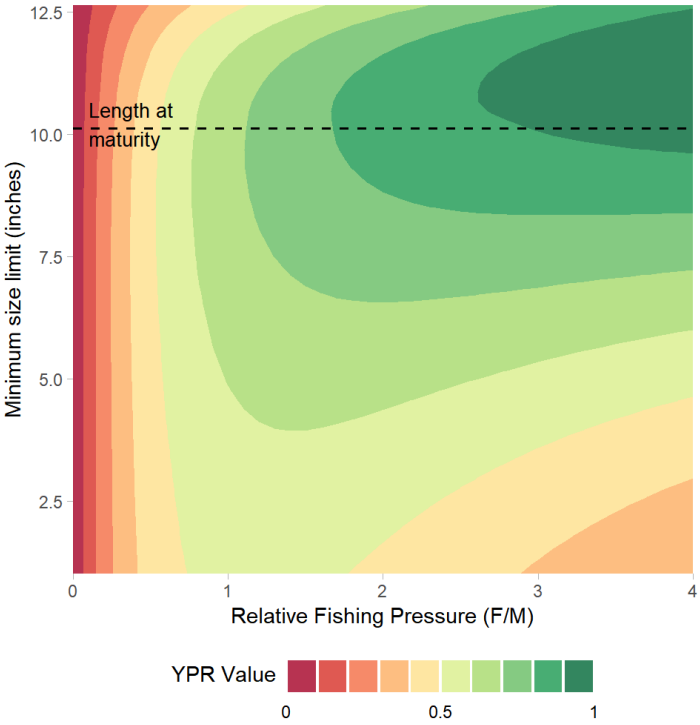
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Acanthurus blochii

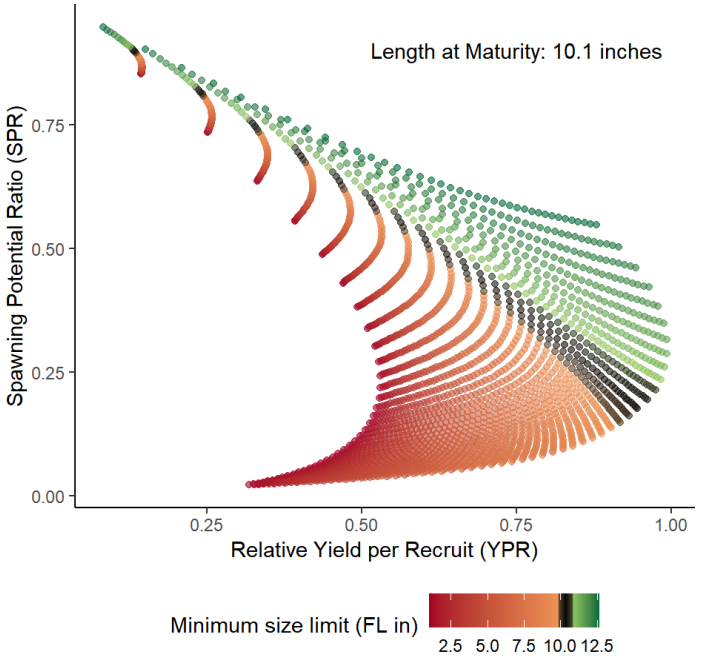
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Acanthurus blochii

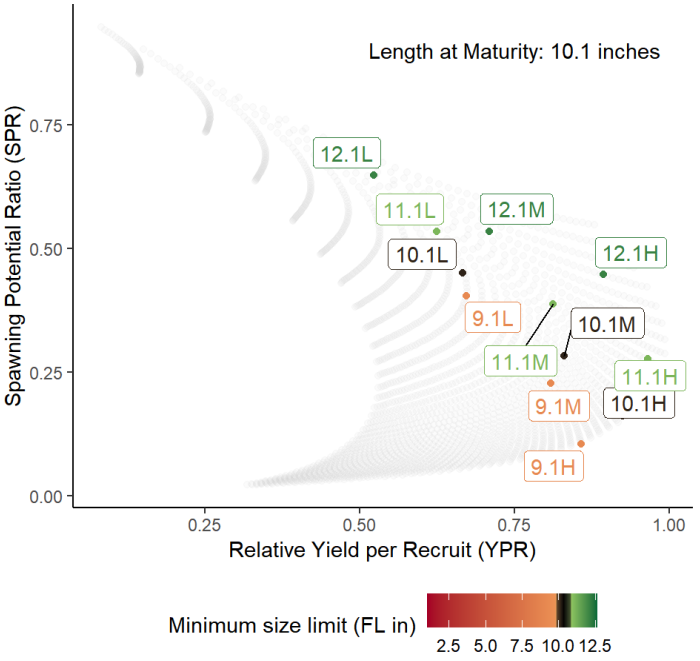
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Acanthurus blochii

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Acanthurus dussumieri**

Hawaiian Name: Palani

Common Name: Eyestriped Surgeonfish

Family: Surgeonfishes

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 371 mm FL

K (von Bertalanffy growth parameter): 0.296 per year

t0 (von Bertalanffy parameter): -0.29

Lm (Length at maturity): 282 mm FL

Lm (Length at maturity): 11 inches FL

M (natural mortality rate): 0.11 per year

Longevity: 28 years

M/K: 0.37

Lm/Loo: 0.76

Acanthurus dussumieri - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	254	10.0	**0.41**	**0.23**	**0.11**
1 x Lm	282	11.1	**0.45**	**0.28**	**0.16**
1.1 x Lm	310	12.2	**0.53**	**0.38**	**0.27**
1.2 x Lm	338	13.3	**0.65**	**0.54**	**0.45**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

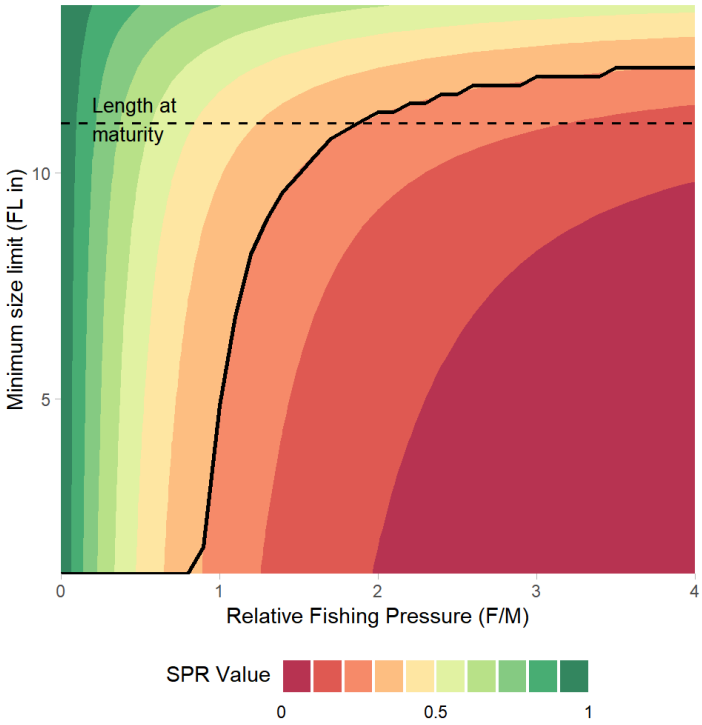
Acanthurus dussumieri - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	254	10.0	**0.70**	**0.84**	**0.89**
1 x Lm	282	11.1	**0.69**	**0.86**	**0.95**
1.1 x Lm	310	12.2	**0.66**	**0.85**	**1.00**
1.2 x Lm	338	13.3	**0.54**	**0.72**	**0.91**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Acanthurus dussumieri

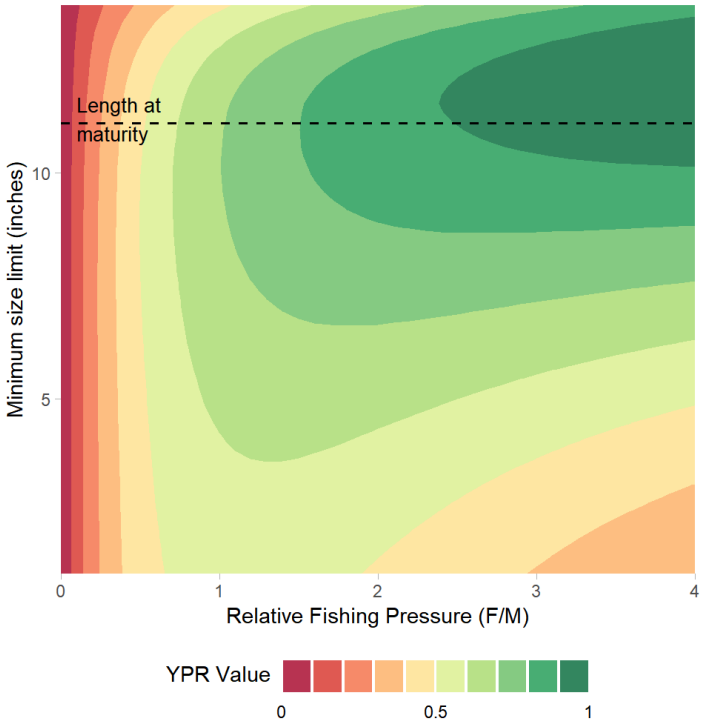
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Acanthurus dussumieri

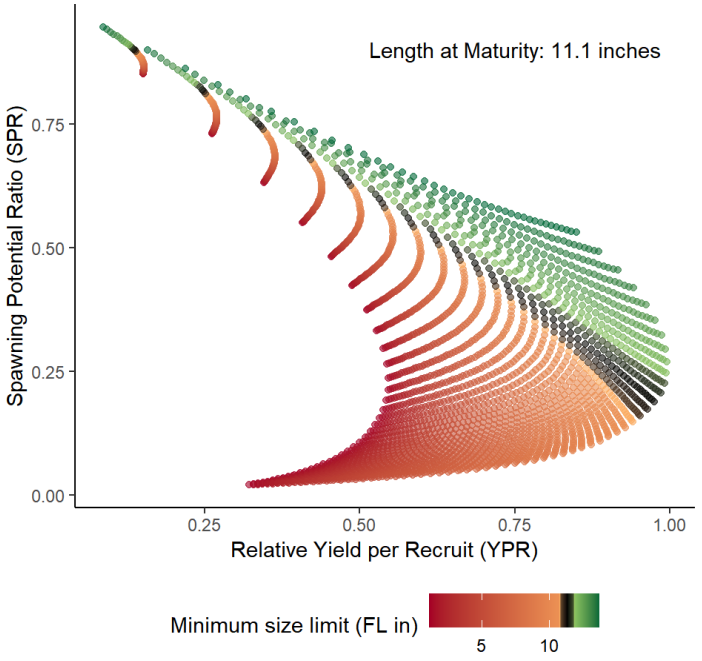
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Acanthurus dussumieri

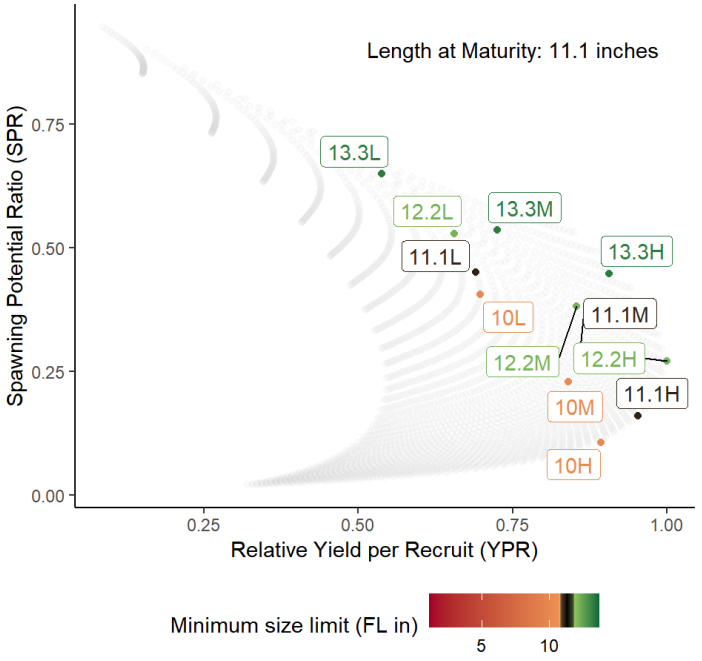
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Acanthurus dussumieri

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Acanthurus triostegus sandvicensis**

Hawaiian Name: Manini

Common Name: Convict Tang

Family: Surgeonfishes

Current Minimum Size Limit (FL): 5 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 177 mm FL

K (von Bertalanffy growth parameter): 1.4308 per year

t0 (von Bertalanffy parameter): 0.0511

Lm (Length at maturity): 156 mm FL

Lm (Length at maturity): 6 inches FL

M (natural mortality rate): 0.97 per year

Longevity: NA years

M/K: 0.68

Lm/Loo: 0.88

Acanthurus triostegus sandvicensis - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	140	5.5	**0.38**	**0.21**	**0.11**
1 x Lm	156	6.1	**0.55**	**0.42**	**0.33**
Current size limit	127	5.0	**0.28**	**0.11**	**0.03**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

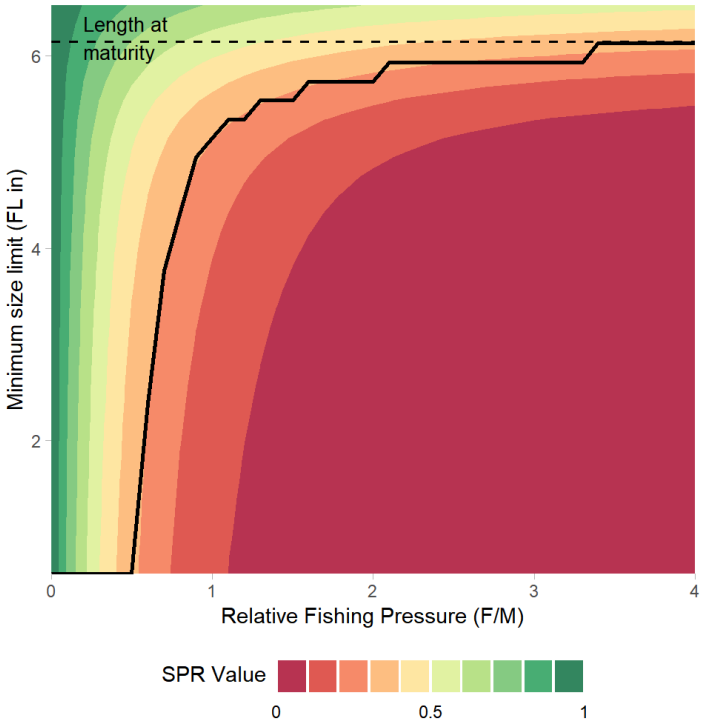
Acanthurus triostegus sandvicensis - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	140	5.5	**0.56**	**0.76**	**1.00**
1 x Lm	156	6.1	**0.46**	**0.67**	**0.95**
Current size limit	127	5.0	**0.59**	**0.76**	**0.91**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Acanthurus triostegus sandvicensis

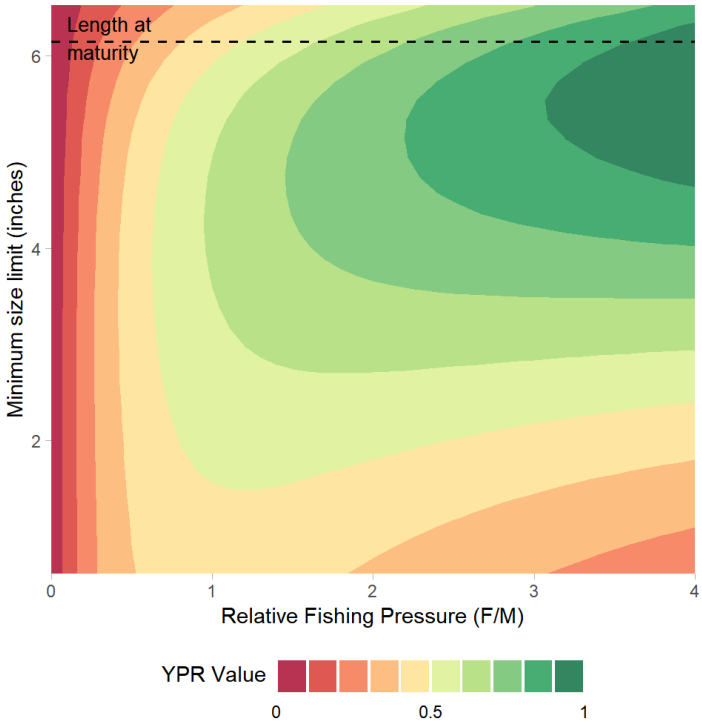
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Acanthurus triostegus sandvicensis

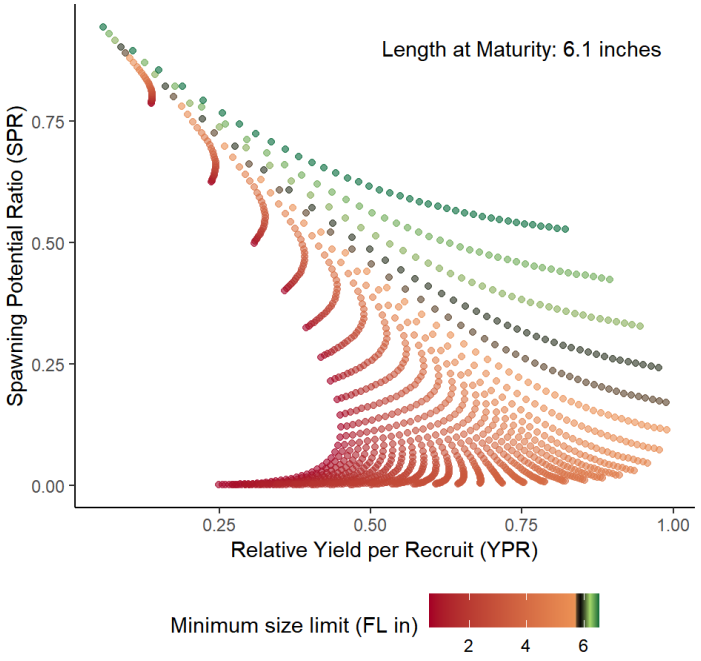
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Acanthurus triostegus sandvicensis

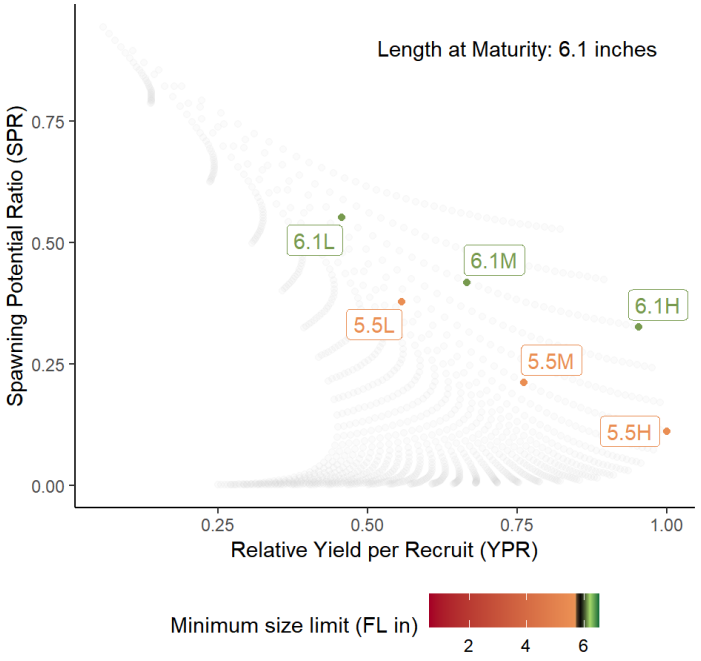
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Acanthurus triostegus sandvicensis

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Acanthurus xanthopterus**

Hawaiian Name: Pualu

Common Name: Yellowfin Surgeonfish

Family: Surgeonfishes

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 501 mm FL

K (von Bertalanffy growth parameter): 0.287 per year

t0 (von Bertalanffy parameter): -0.21

Lm (Length at maturity): 431 mm FL

Lm (Length at maturity): 17 inches FL

M (natural mortality rate): 0.09 per year

Longevity: 34 years

M/K: 0.31

Lm/Loo: 0.86

Acanthurus xanthopterus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	388	15.3	**0.41**	**0.23**	**0.11**
1 x Lm	431	17.0	**0.50**	**0.34**	**0.22**
1.1 x Lm	474	18.7	**0.66**	**0.55**	**0.46**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

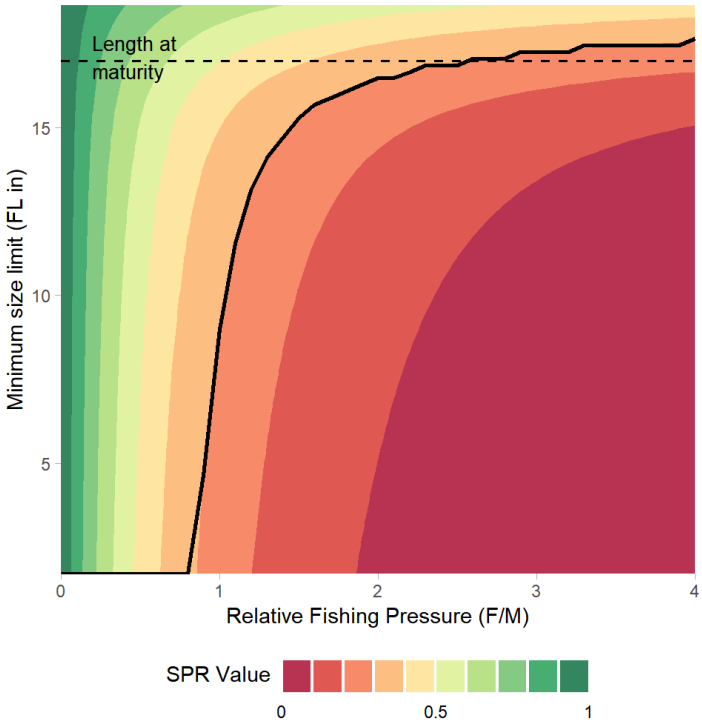
Acanthurus xanthopterus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	388	15.3	**0.70**	**0.88**	**0.98**
1 x Lm	431	17.0	**0.65**	**0.85**	**1.00**
1.1 x Lm	474	18.7	**0.49**	**0.68**	**0.87**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Acanthurus xanthopterus

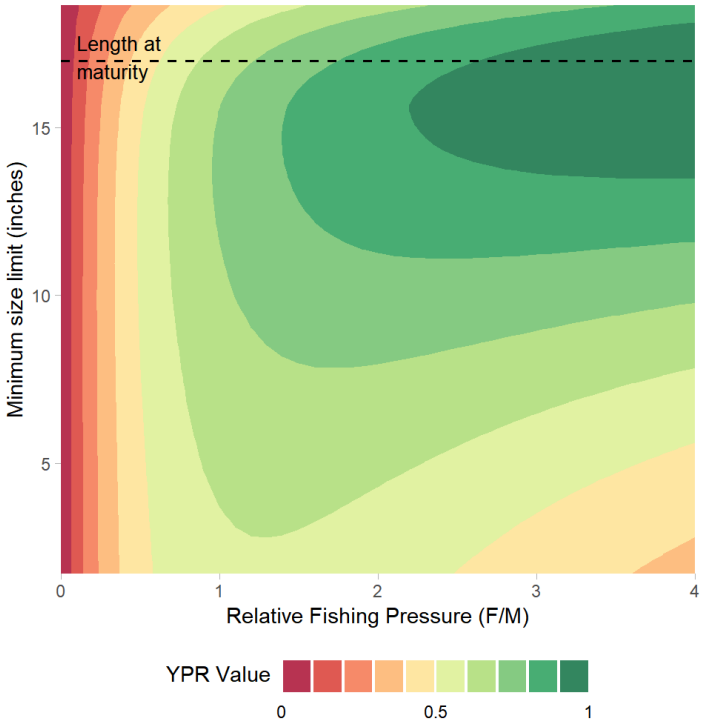
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Acanthurus xanthopterus

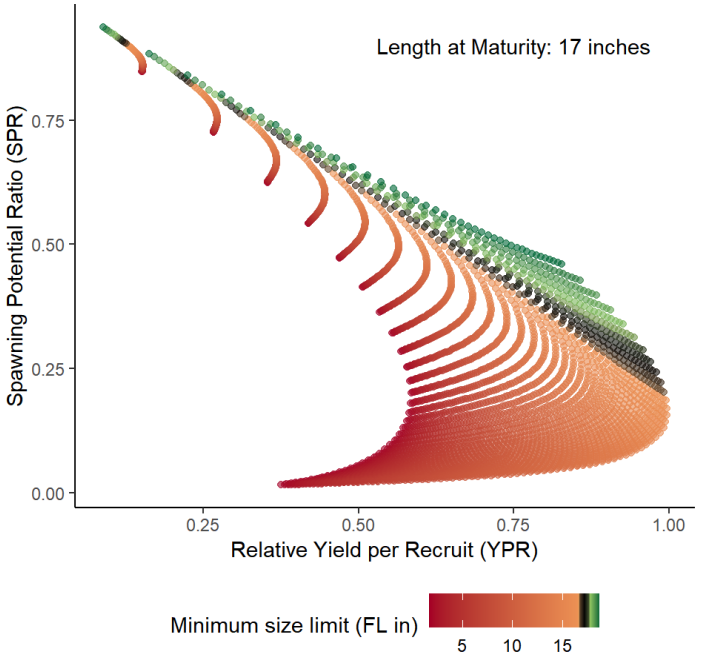
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Acanthurus xanthopterus

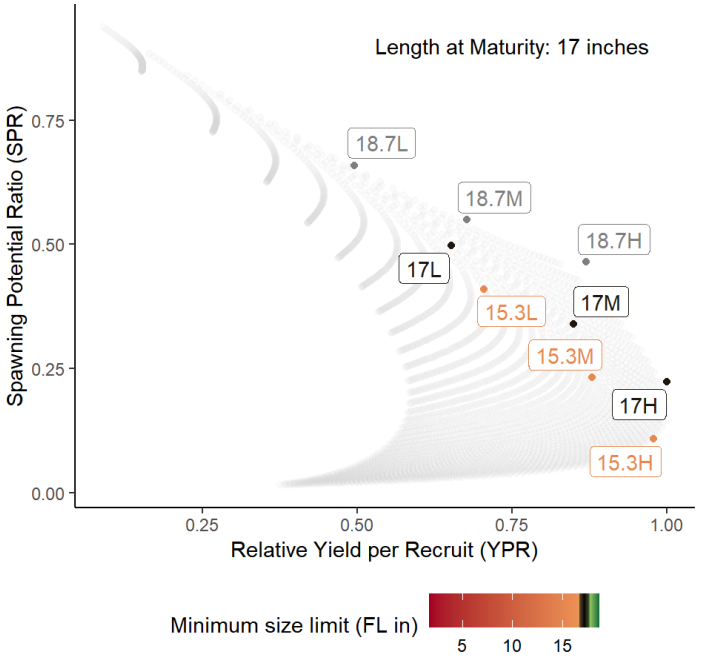
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Acanthurus xanthopterus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Ctenochaetus strigosus**

Hawaiian Name: Kole

Common Name: Goldring Surgeonfish

Family: Surgeonfishes

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 178 mm FL

K (von Bertalanffy growth parameter): 0.423 per year

t0 (von Bertalanffy parameter): -0.51

Lm (Length at maturity): 84 mm FL

Lm (Length at maturity): 3 inches FL

M (natural mortality rate): 0.08 per year

Longevity: 39 years

M/K: 0.19

Lm/Loo: 0.47

Ctenochaetus strigosus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	76	3.0	**0.41**	**0.24**	**0.11**
1 x Lm	84	3.3	**0.42**	**0.25**	**0.12**
1.1 x Lm	92	3.6	**0.43**	**0.25**	**0.12**
1.2 x Lm	101	4.0	**0.44**	**0.26**	**0.14**
1.3 x Lm	109	4.3	**0.45**	**0.28**	**0.15**
1.5 x Lm	126	5.0	**0.47**	**0.31**	**0.18**
2 x Lm	168	6.6	**0.72**	**0.62**	**0.54**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

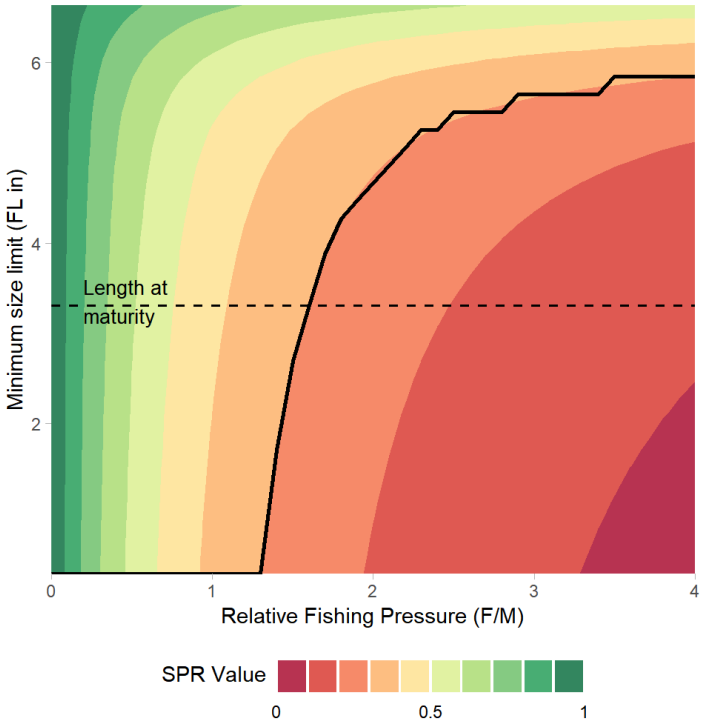
Ctenochaetus strigosus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	76	3.0	**0.55**	**0.63**	**0.59**
1 x Lm	84	3.3	**0.56**	**0.65**	**0.63**
1.1 x Lm	92	3.6	**0.57**	**0.66**	**0.65**
1.2 x Lm	101	4.0	**0.57**	**0.68**	**0.69**
1.3 x Lm	109	4.3	**0.58**	**0.70**	**0.73**
1.5 x Lm	126	5.0	**0.59**	**0.74**	**0.81**
2 x Lm	168	6.6	**0.46**	**0.65**	**0.87**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Ctenochaetus strigosus

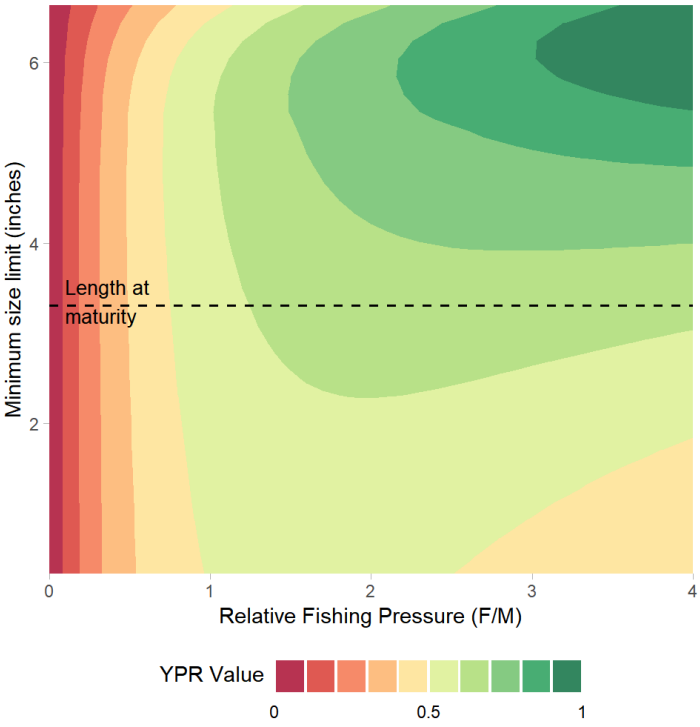
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Ctenochaetus strigosus

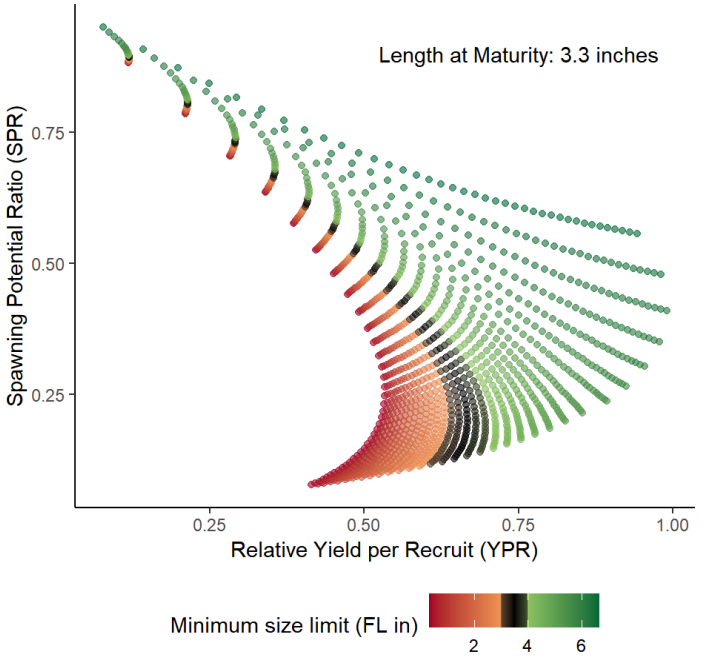
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Ctenochaetus strigosus

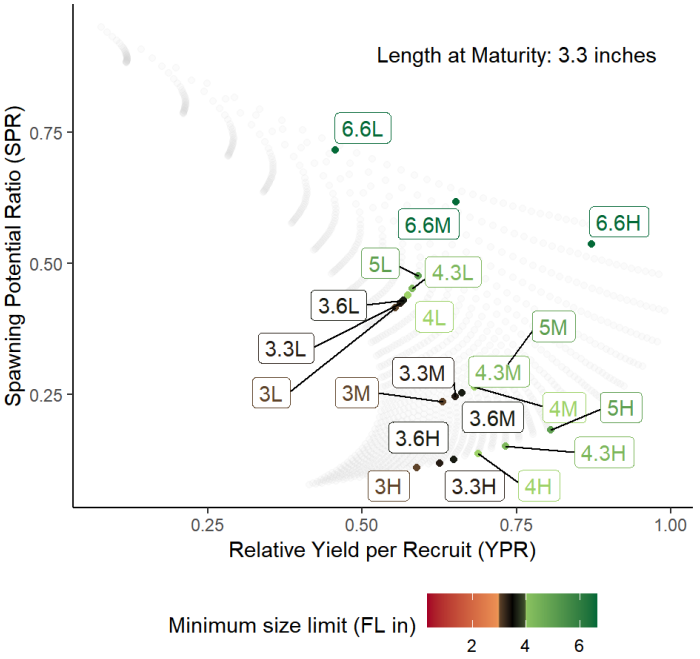
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Ctenochaetus strigosus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Ctenochaetus strigosus - female**

Hawaiian Name: Kole

Common Name: Goldring Surgeonfish

Family: Surgeonfishes

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 115 mm FL

K (von Bertalanffy growth parameter): 0.6553 per year

t0 (von Bertalanffy parameter): -1.2811

Lm (Length at maturity): 84 mm FL

Lm (Length at maturity): 3 inches FL

M (natural mortality rate): 0.18 per year

Longevity: 18 years

M/K: 0.27

Lm/Loo: 0.73

Ctenochaetus strigosus - female - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	76	3.0	**0.43**	**0.26**	**0.13**
1 x Lm	84	3.3	**0.47**	**0.31**	**0.18**
1.1 x Lm	92	3.6	**0.51**	**0.36**	**0.24**
1.2 x Lm	101	4.0	**0.61**	**0.49**	**0.39**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

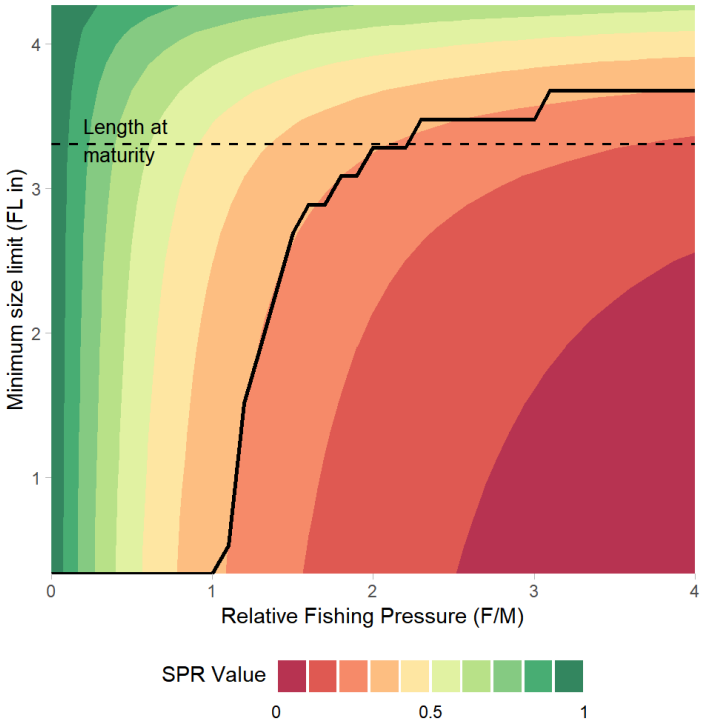
Ctenochaetus strigosus - female - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	76	3.0	**0.49**	**0.60**	**0.66**
1 x Lm	84	3.3	**0.50**	**0.64**	**0.75**
1.1 x Lm	92	3.6	**0.49**	**0.66**	**0.80**
1.2 x Lm	101	4.0	**0.48**	**0.69**	**0.97**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Ctenochaetus strigosus - female

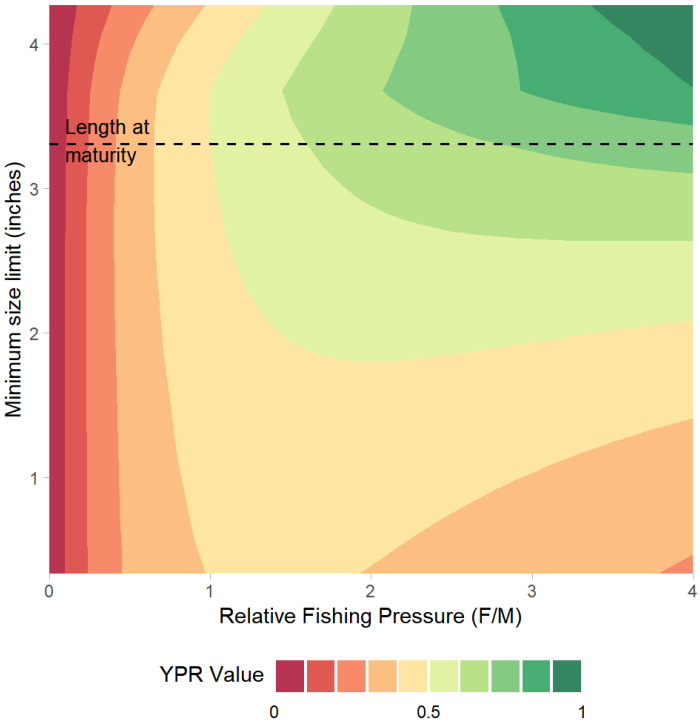
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Ctenochaetus strigosus - female

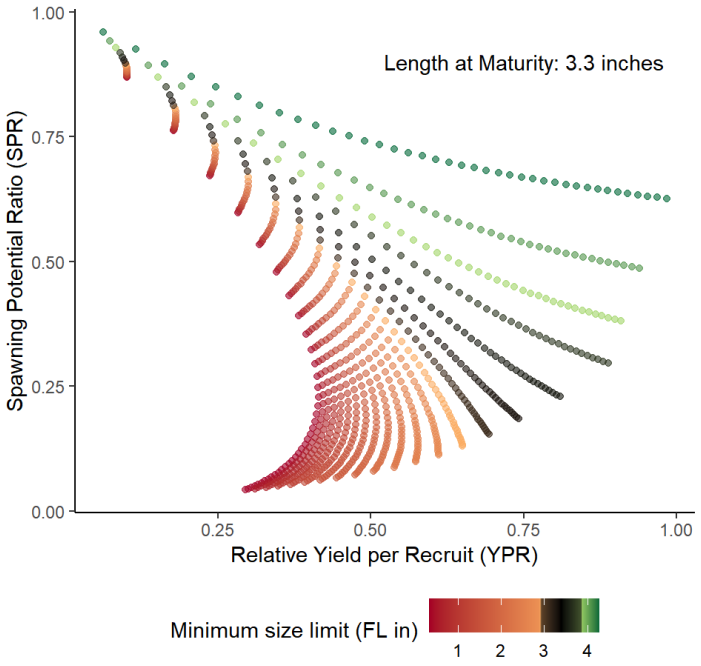
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Ctenochaetus strigosus - female

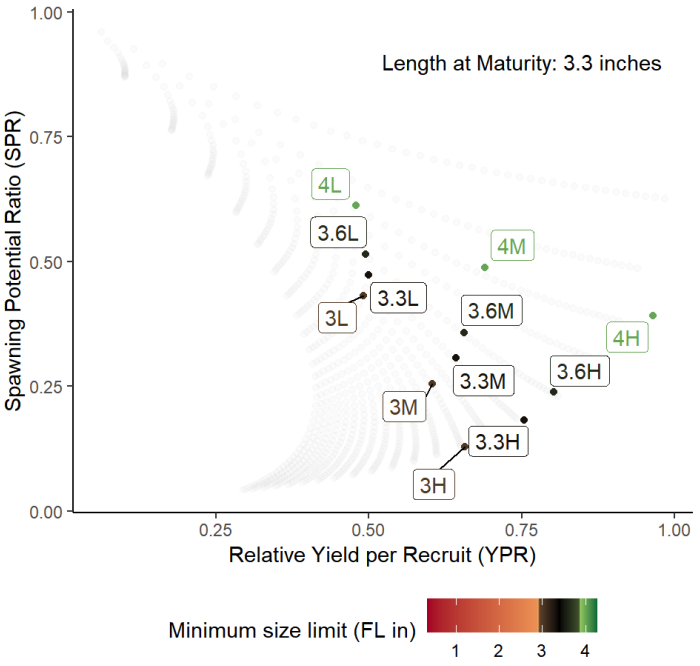
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Ctenochaetus strigosus - female

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Ctenochaetus strigosus - male**

Hawaiian Name: Kole

Common Name: Goldring Surgeonfish

Family: Surgeonfishes

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 146 mm FL

K (von Bertalanffy growth parameter): 0.5099 per year

t0 (von Bertalanffy parameter): -1.0542

Lm (Length at maturity): 100 mm FL

Lm (Length at maturity): 4 inches FL

M (natural mortality rate): 0.18 per year

Longevity: 18 years

M/K: 0.35

Lm/Loo: 0.69

Ctenochaetus strigosus - male - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	90	3.5	**0.41**	**0.23**	**0.11**
1 x Lm	100	3.9	**0.44**	**0.27**	**0.15**
1.1 x Lm	110	4.3	**0.48**	**0.33**	**0.21**
1.2 x Lm	120	4.7	**0.55**	**0.41**	**0.31**
1.3 x Lm	130	5.1	**0.65**	**0.54**	**0.45**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

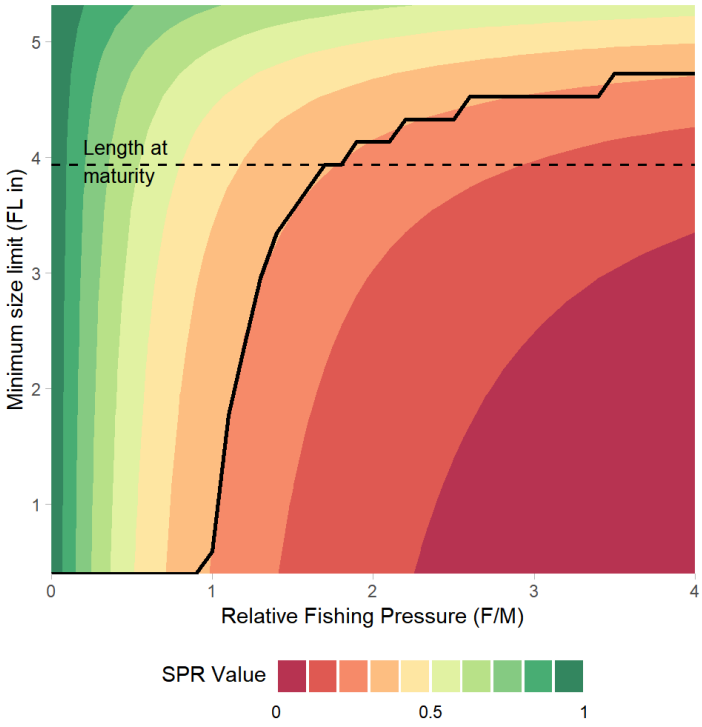
Ctenochaetus strigosus - male - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	90	3.5	**0.53**	**0.63**	**0.66**
1 x Lm	100	3.9	**0.54**	**0.66**	**0.74**
1.1 x Lm	110	4.3	**0.54**	**0.69**	**0.82**
1.2 x Lm	120	4.7	**0.53**	**0.72**	**0.93**
1.3 x Lm	130	5.1	**0.49**	**0.71**	**1.00**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Ctenochaetus strigosus - male

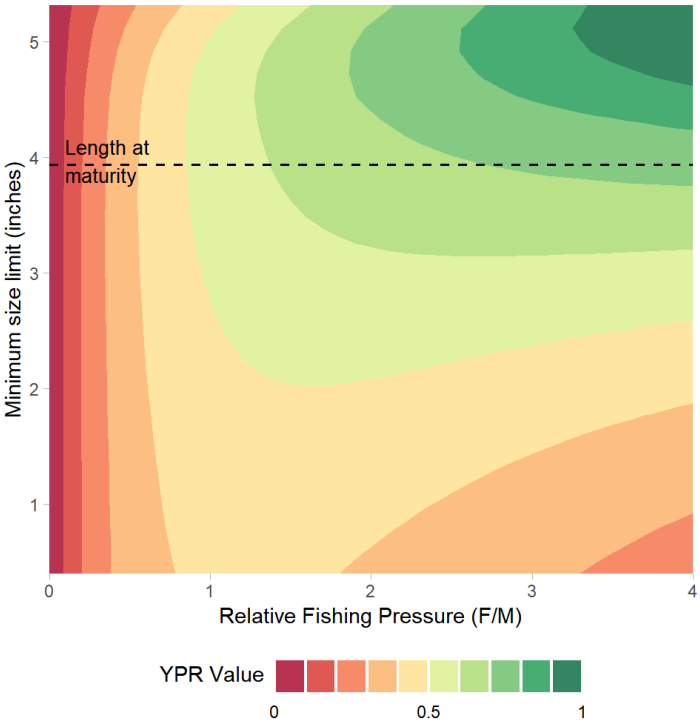
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Ctenochaetus strigosus - male

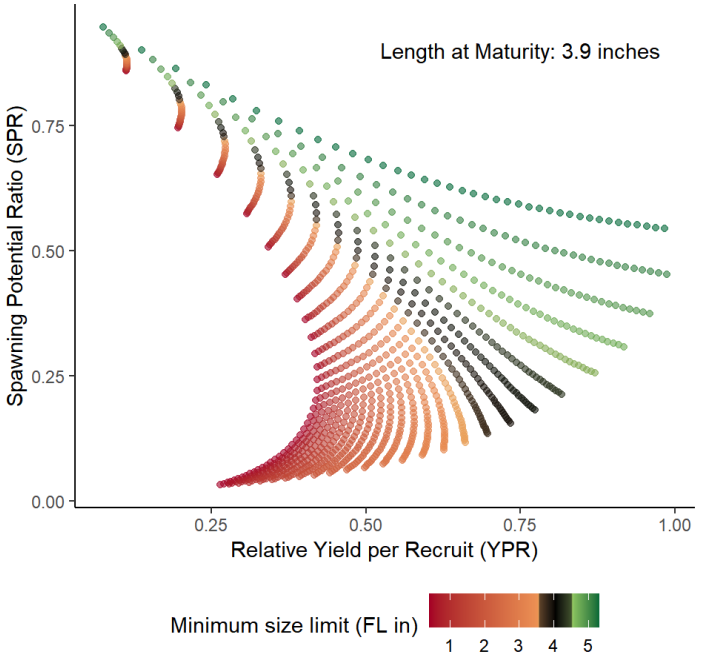
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Ctenochaetus strigosus - male

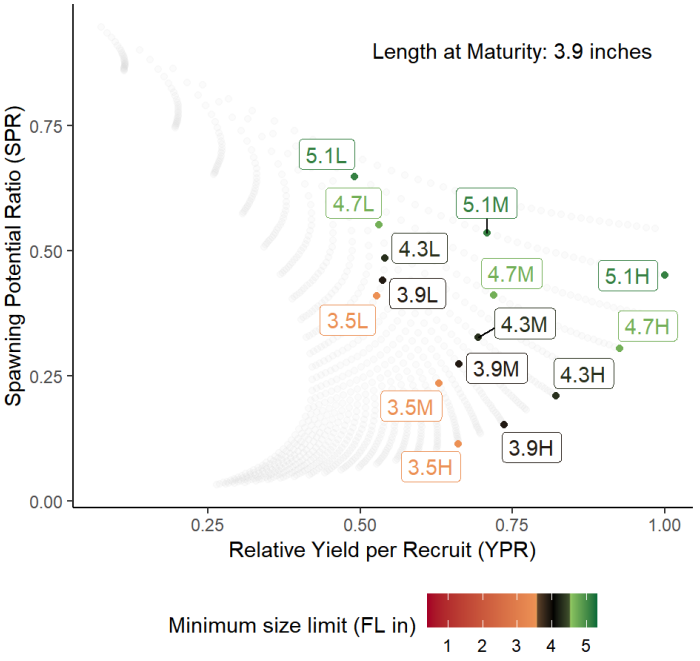
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Ctenochaetus strigosus - male

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Naso brevirostris**

Hawaiian Name: Kala Lolo

Common Name: Paletail Unicornfish

Family: Surgeonfishes

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 327 mm FL

K (von Bertalanffy growth parameter): 0.402 per year

t0 (von Bertalanffy parameter): -0.21

Lm (Length at maturity): 269 mm FL

Lm (Length at maturity): 11 inches FL

M (natural mortality rate): 0.13 per year

Longevity: 25 years

M/K: 0.32

Lm/Loo: 0.82

Naso brevirostris - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	242	9.5	**0.41**	**0.23**	**0.11**
1 x Lm	269	10.6	**0.48**	**0.32**	**0.20**
1.1 x Lm	296	11.7	**0.59**	**0.46**	**0.36**
Current size limit	0	0.0	**0.26**	**0.10**	**0.02**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

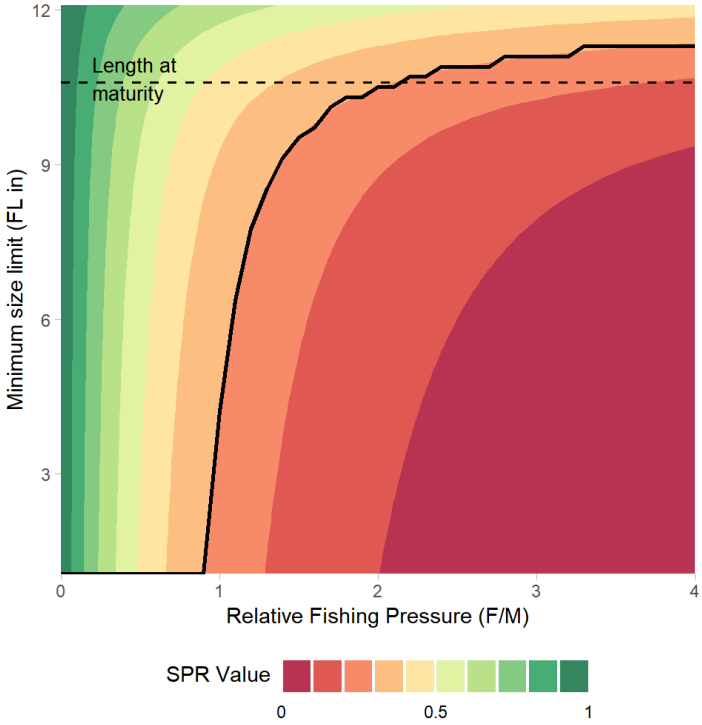
Naso brevirostris - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	242	9.5	**0.68**	**0.84**	**0.91**
1 x Lm	269	10.6	**0.67**	**0.86**	**1.00**
1.1 x Lm	296	11.7	**0.59**	**0.80**	**1.00**
Current size limit	0	0.0	**0.53**	**0.48**	**0.30**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Naso brevirostris

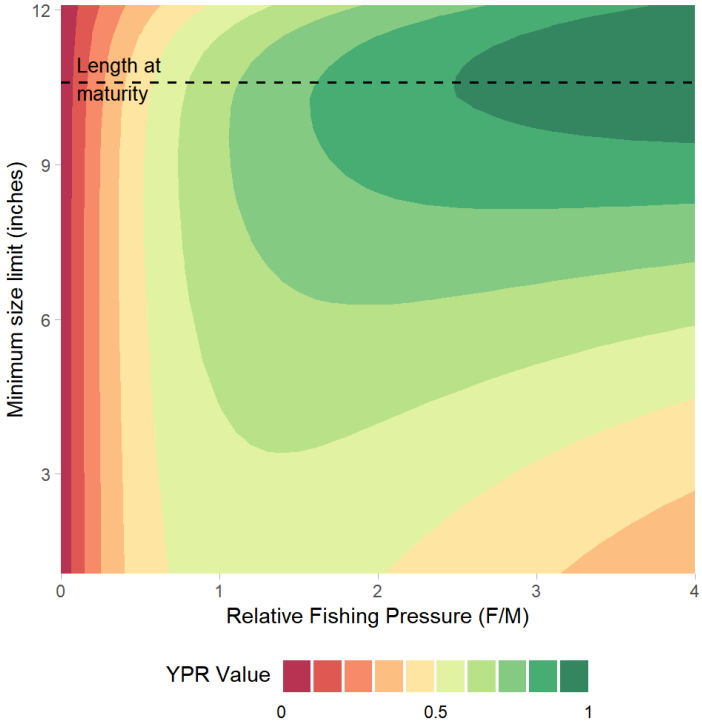
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Naso brevirostris

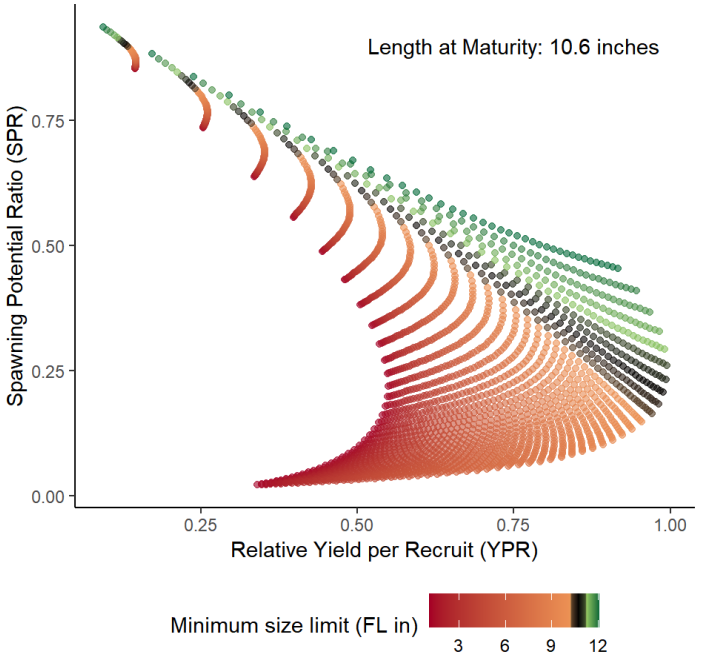
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Naso brevirostris

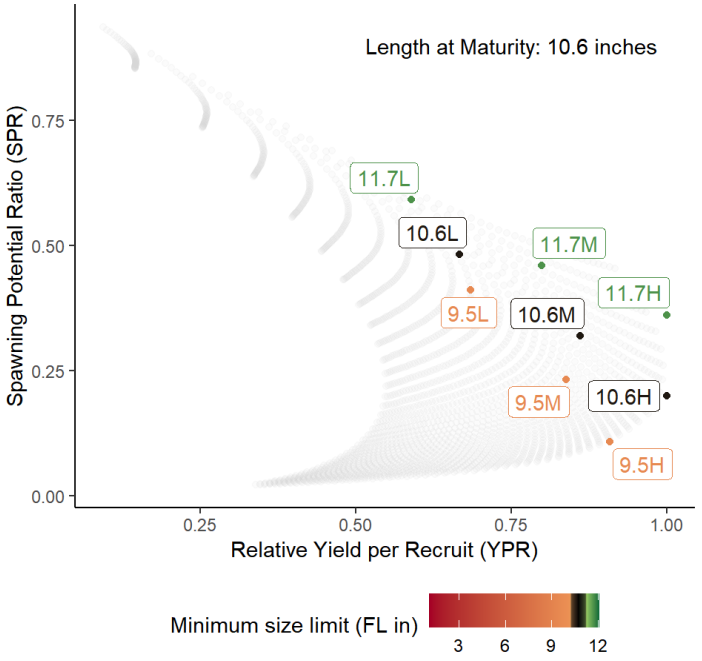
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Naso brevirostris

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Naso hexacanthus**

Hawaiian Name: ‘Opelu kala

Common Name: Sleek Unicornfish

Family: Surgeonfishes

Current Minimum Size Limit (FL): 16 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 599 mm FL

K (von Bertalanffy growth parameter): 0.221 per year

t0 (von Bertalanffy parameter): -0.22

Lm (Length at maturity): 511 mm FL

Lm (Length at maturity): 20 inches FL

M (natural mortality rate): 0.07 per year

Longevity: 44 years

M/K: 0.32

Lm/Loo: 0.85

Naso hexacanthus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	460	18.1	**0.41**	**0.23**	**0.11**
1 x Lm	511	20.1	**0.49**	**0.34**	**0.22**
1.1 x Lm	562	22.1	**0.64**	**0.52**	**0.43**
Current size limit	406	16.0	**0.36**	**0.18**	**0.06**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

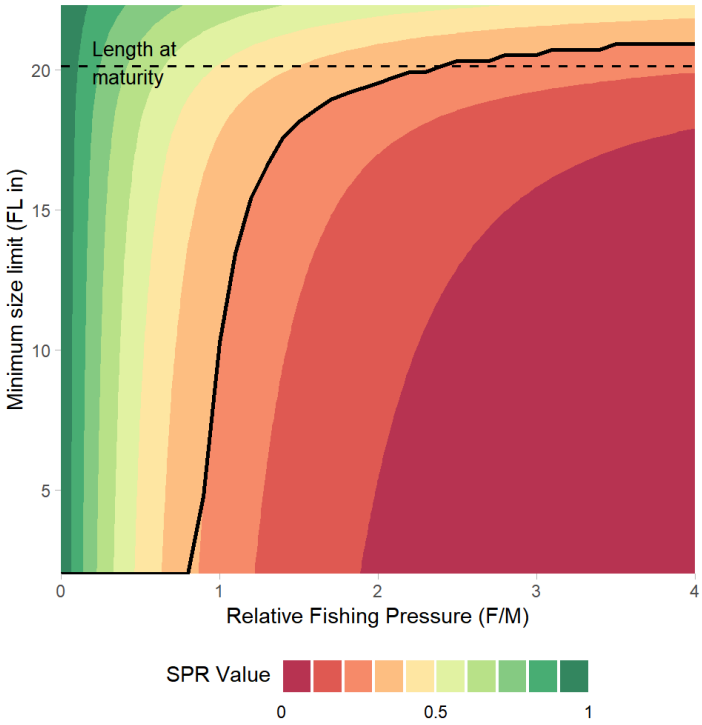
Naso hexacanthus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	460	18.1	**0.71**	**0.88**	**0.98**
1 x Lm	511	20.1	**0.65**	**0.84**	**0.99**
1.1 x Lm	562	22.1	**0.50**	**0.67**	**0.83**
Current size limit	406	16.0	**0.71**	**0.86**	**0.90**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Naso hexacanthus

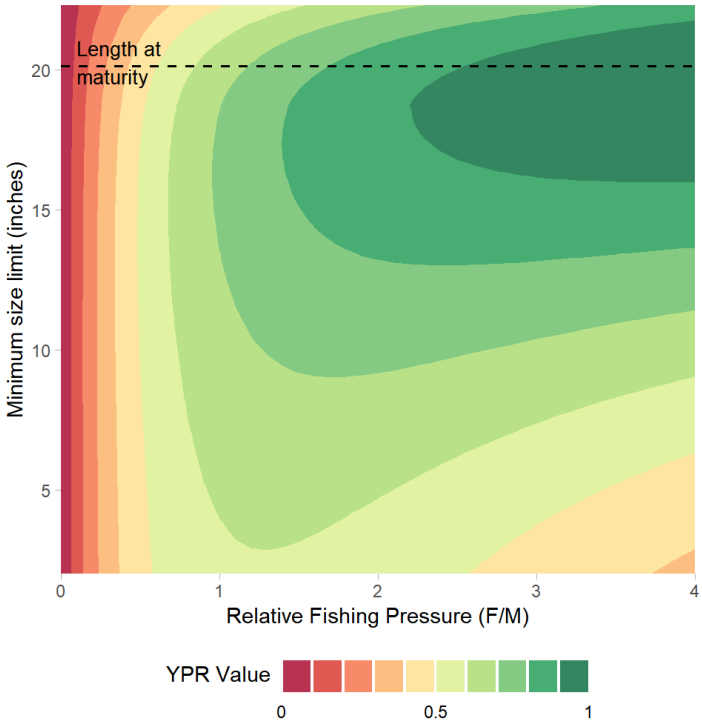
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Naso hexacanthus

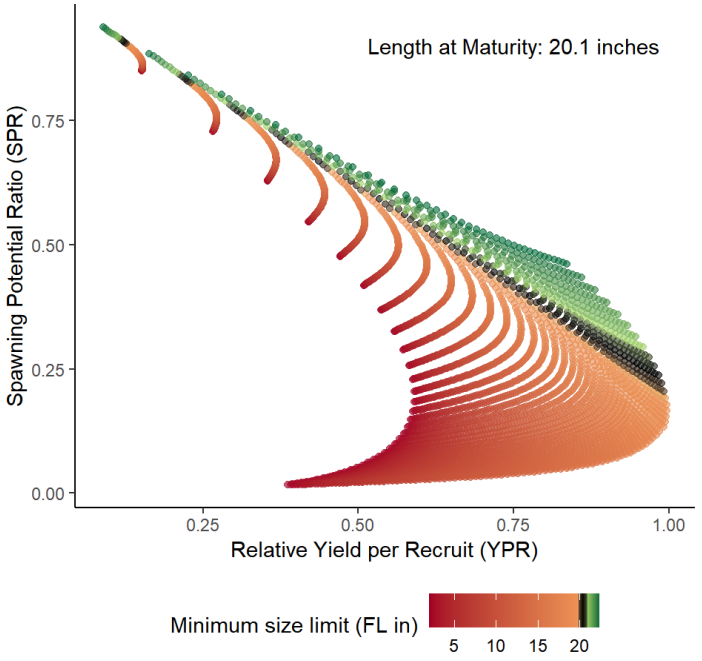
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Naso hexacanthus

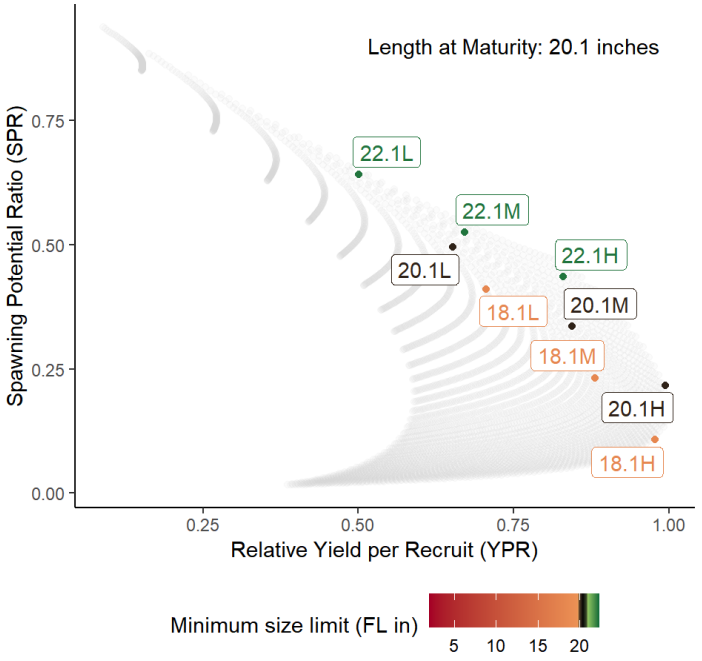
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Naso hexacanthus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Naso lituratus**

Hawaiian Name: Umauma lei

Common Name: Orangespine Unicornfish

Family: Surgeonfishes

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 256 mm FL

K (von Bertalanffy growth parameter): 0.3408 per year

t0 (von Bertalanffy parameter): -0.66

Lm (Length at maturity): 199 mm FL

Lm (Length at maturity): 8 inches FL

M (natural mortality rate): 0.13 per year

Longevity: 25 years

M/K: 0.38

Lm/Loo: 0.78

Naso lituratus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	179	7.0	**0.41**	**0.24**	**0.11**
1 x Lm	199	7.8	**0.47**	**0.31**	**0.19**
1.1 x Lm	219	8.6	**0.56**	**0.43**	**0.32**
1.2 x Lm	239	9.4	**0.70**	**0.60**	**0.53**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

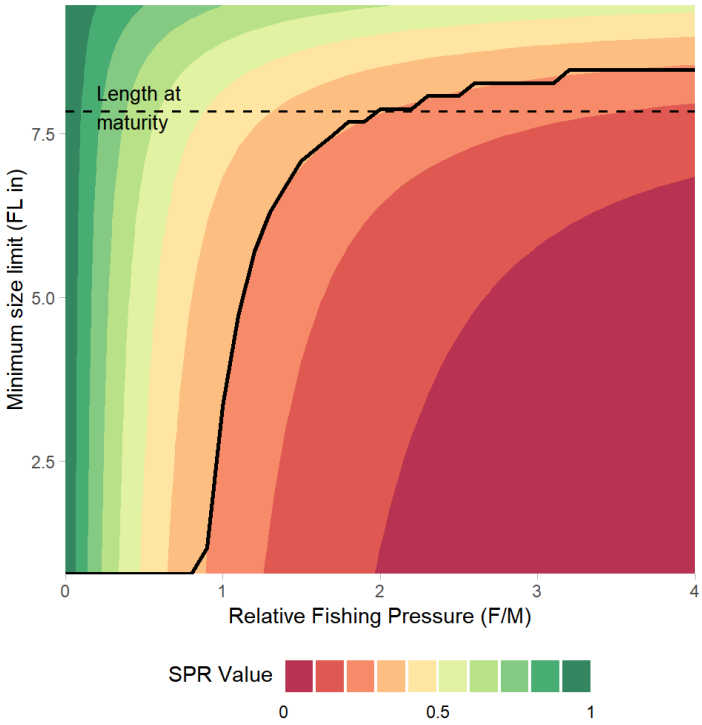
Naso lituratus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	179	7.0	**0.64**	**0.79**	**0.87**
1 x Lm	199	7.8	**0.63**	**0.81**	**0.96**
1.1 x Lm	219	8.6	**0.58**	**0.79**	**1.00**
1.2 x Lm	239	9.4	**0.47**	**0.67**	**0.92**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Naso lituratus

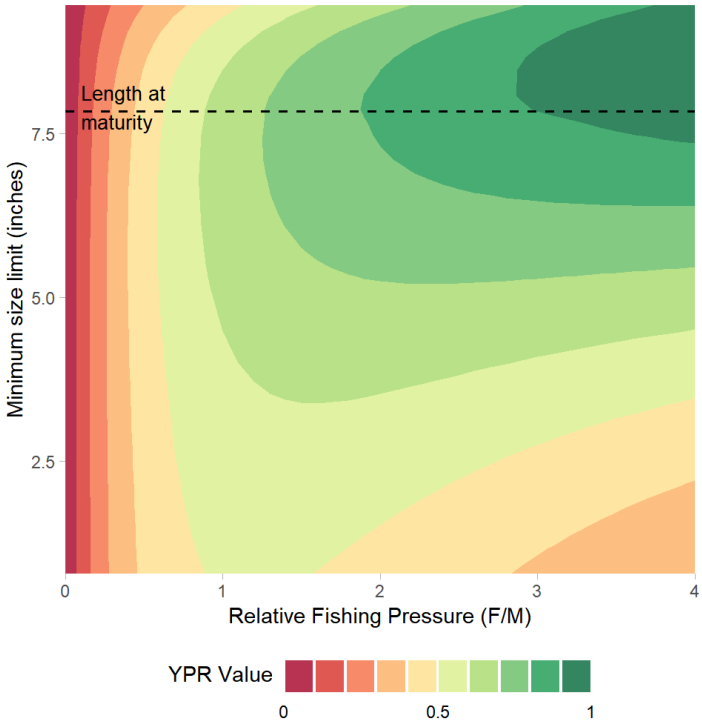
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Naso lituratus

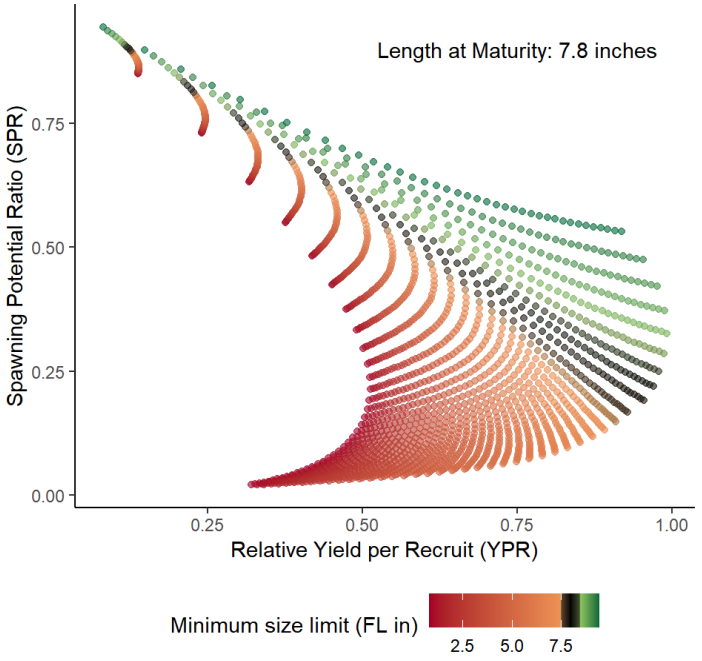
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Naso lituratus

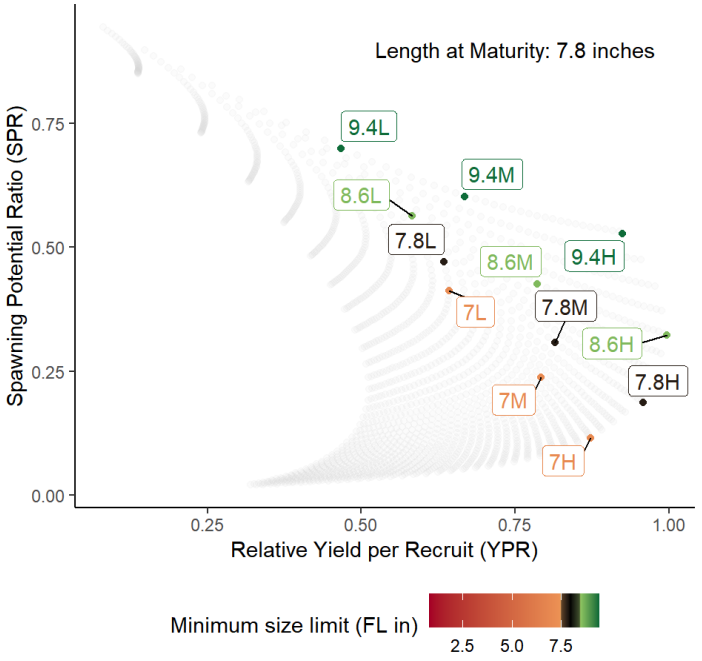
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Naso lituratus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Naso unicornis - male**

Hawaiian Name: Kala

Common Name: Bluespine Unicornfish

Family: Surgeonfishes

Current Minimum Size Limit (FL): 14 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 476 mm FL

K (von Bertalanffy growth parameter): 0.46 per year

t0 (von Bertalanffy parameter): -0.11

Lm (Length at maturity): 301 mm FL

Lm (Length at maturity): 12 inches FL

M (natural mortality rate): 0.06 per year

Longevity: 50 years

M/K: 0.13

Lm/Loo: 0.63

Naso unicornis - male - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	271	10.7	**0.44**	**0.26**	**0.13**
1 x Lm	301	11.9	**0.45**	**0.28**	**0.14**
1.1 x Lm	331	13.0	**0.46**	**0.29**	**0.16**
1.2 x Lm	361	14.2	**0.48**	**0.31**	**0.18**
1.3 x Lm	391	15.4	**0.51**	**0.35**	**0.22**
1.5 x Lm	452	17.8	**0.65**	**0.54**	**0.45**
Current size limit	356	14.0	**0.48**	**0.31**	**0.18**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

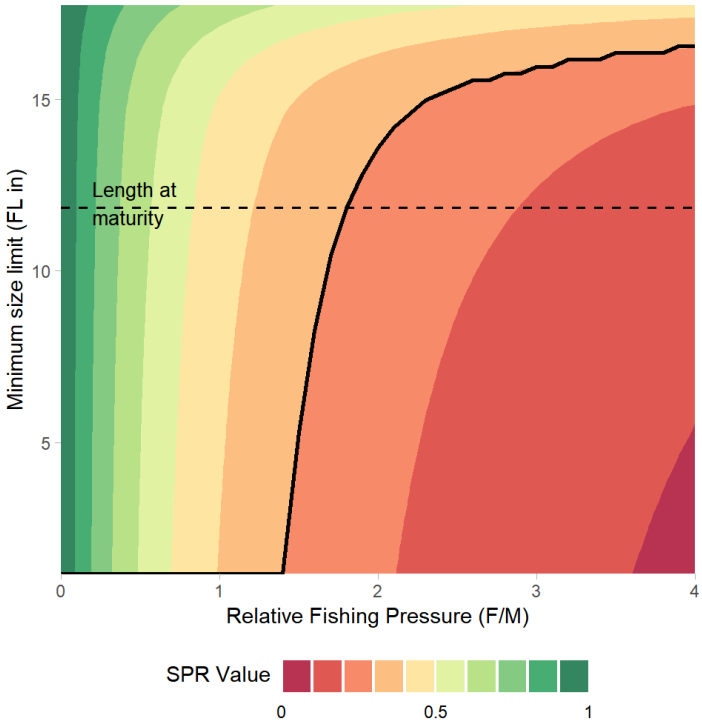
Naso unicornis - male - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	271	10.7	**0.66**	**0.80**	**0.81**
1 x Lm	301	11.9	**0.67**	**0.82**	**0.85**
1.1 x Lm	331	13.0	**0.67**	**0.83**	**0.90**
1.2 x Lm	361	14.2	**0.67**	**0.85**	**0.94**
1.3 x Lm	391	15.4	**0.67**	**0.86**	**0.99**
1.5 x Lm	452	17.8	**0.52**	**0.71**	**0.88**
Current size limit	356	14.0	**0.67**	**0.85**	**0.93**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Naso unicornis - male

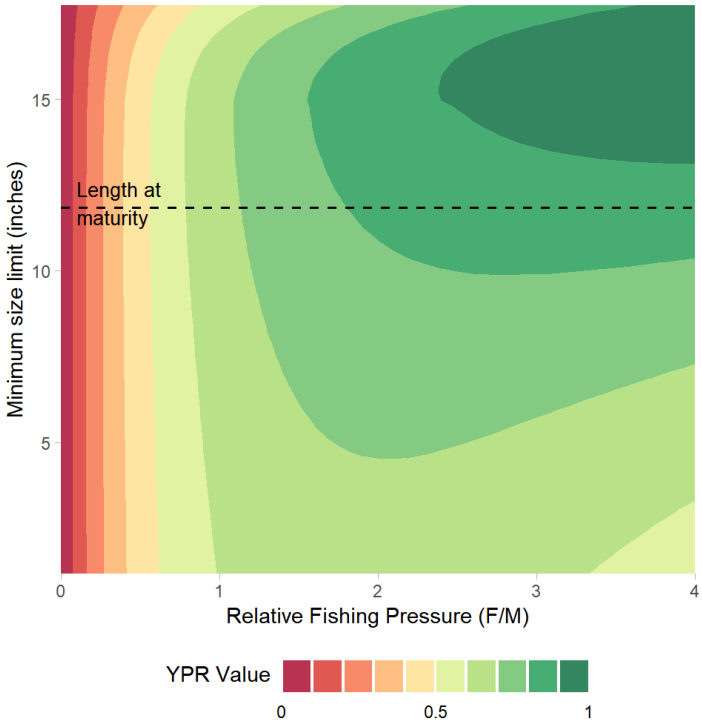
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Naso unicornis - male

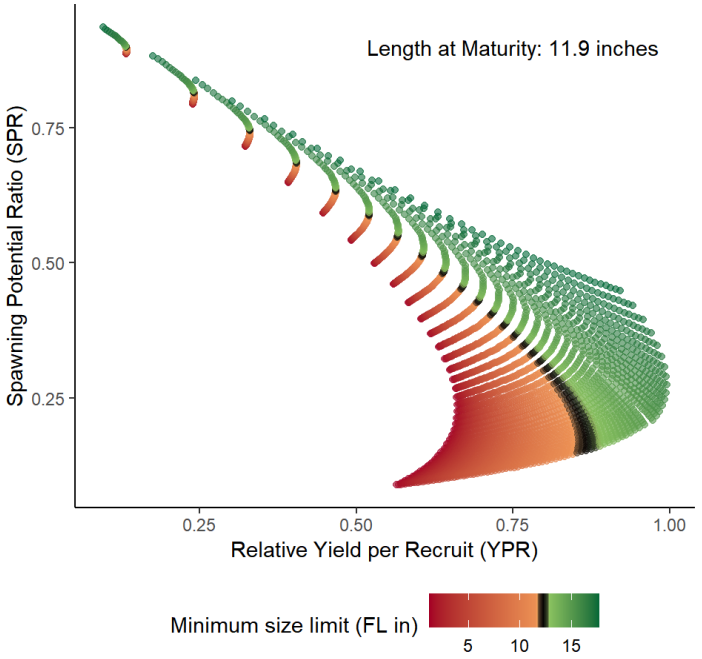
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Naso unicornis - male

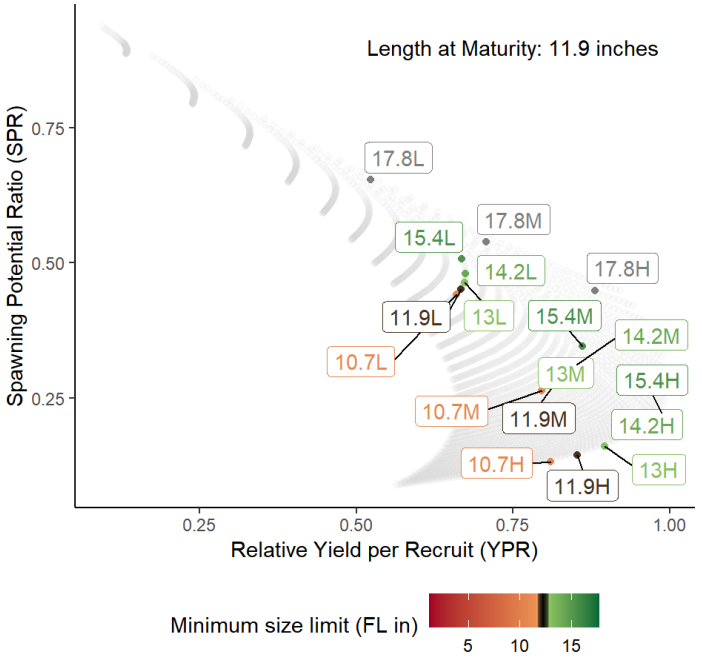
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Naso unicornis - male

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Naso unicornis - female**

Hawaiian Name: Kala

Common Name: Bluespine Unicornfish

Family: Surgeonfishes

Current Minimum Size Limit (FL): 14 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 480 mm FL

K (von Bertalanffy growth parameter): 0.43 per year

t0 (von Bertalanffy parameter): -0.14

Lm (Length at maturity): 355 mm FL

Lm (Length at maturity): 14 inches FL

M (natural mortality rate): 0.06 per year

Longevity: 50 years

M/K: 0.14

Lm/Loo: 0.74

Naso unicornis - female - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	320	12.6	**0.45**	**0.27**	**0.14**
1 x Lm	355	14.0	**0.47**	**0.29**	**0.16**
1.1 x Lm	391	15.4	**0.50**	**0.33**	**0.21**
1.2 x Lm	426	16.8	**0.56**	**0.42**	**0.31**
Current size limit	356	14.0	**0.47**	**0.29**	**0.16**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

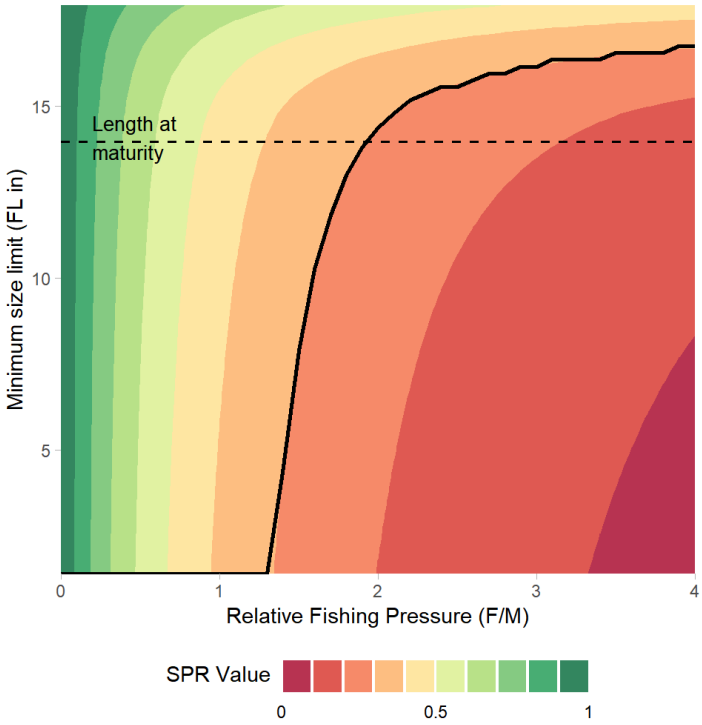
Naso unicornis - female - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	320	12.6	**0.67**	**0.83**	**0.88**
1 x Lm	355	14.0	**0.68**	**0.85**	**0.93**
1.1 x Lm	391	15.4	**0.67**	**0.86**	**0.99**
1.2 x Lm	426	16.8	**0.62**	**0.82**	**0.99**
Current size limit	356	14.0	**0.68**	**0.85**	**0.93**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Naso unicornis - female

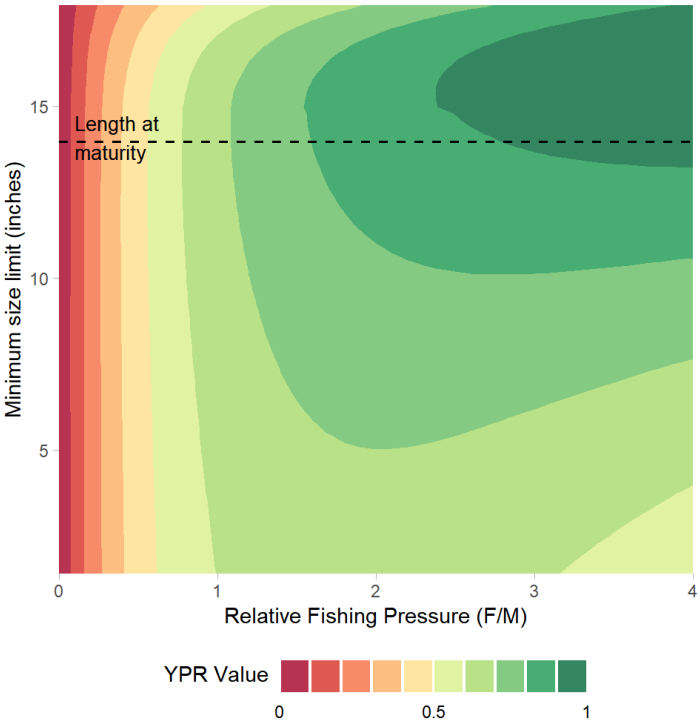
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Naso unicornis - female

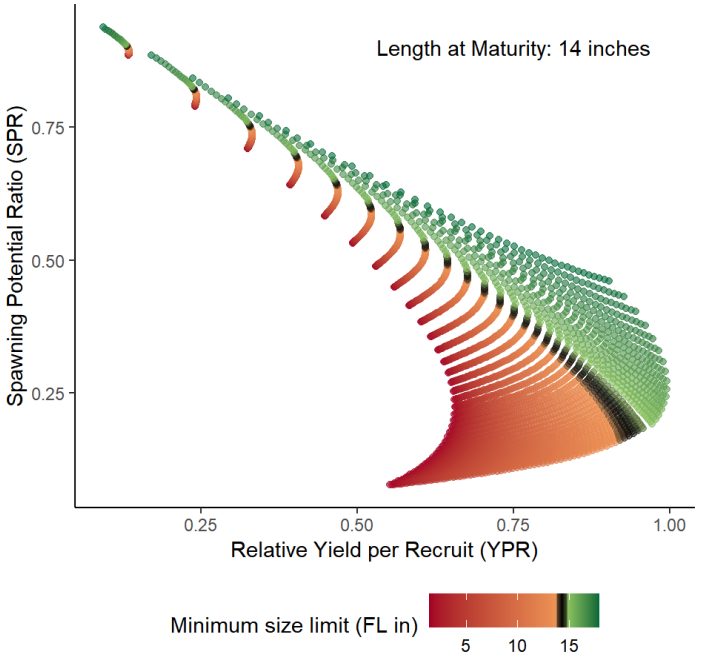
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Naso unicornis - female

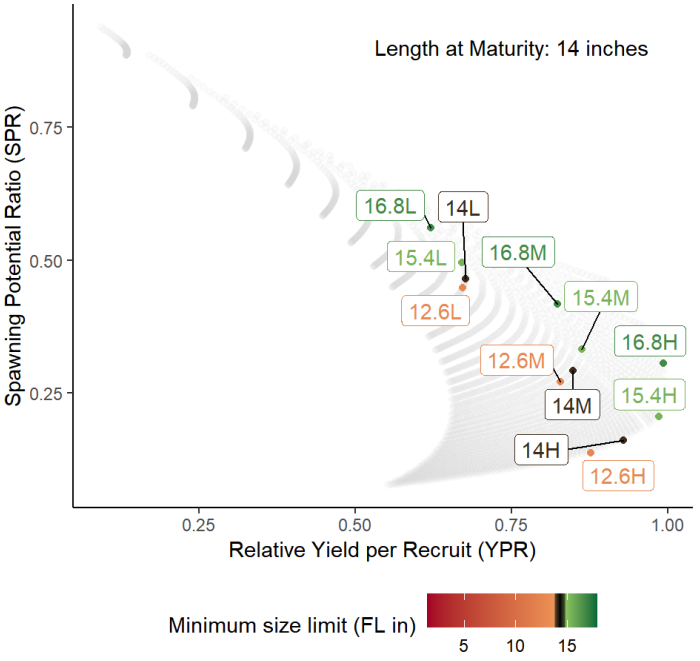
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Naso unicornis - female

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Albulidae - Bonefishes

Species: **Albula glossodonta**

Hawaiian Name: ‘O’io

Common Name: Shortjaw Bonefish

Family: Bonefishes

Current Minimum Size Limit (FL): 14 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 673 mm FL

K (von Bertalanffy growth parameter): 0.18 per year

t0 (von Bertalanffy parameter): -0.68

Lm (Length at maturity): 424 mm FL

Lm (Length at maturity): 17 inches FL

M (natural mortality rate): 0.23 per year

Longevity: 14 years

M/K: 1.28

Lm/Loo: 0.63

Albula glossodonta - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	382	15.0	**0.32**	**0.16**	**0.06**
1 x Lm	424	16.7	**0.40**	**0.24**	**0.14**
1.1 x Lm	466	18.3	**0.48**	**0.33**	**0.24**
1.2 x Lm	509	20.0	**0.58**	**0.46**	**0.38**
1.3 x Lm	551	21.7	**0.68**	**0.59**	**0.52**
1.5 x Lm	636	25.0	**0.88**	**0.84**	**0.81**
Current size limit	356	14.0	**0.29**	**0.13**	**0.04**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

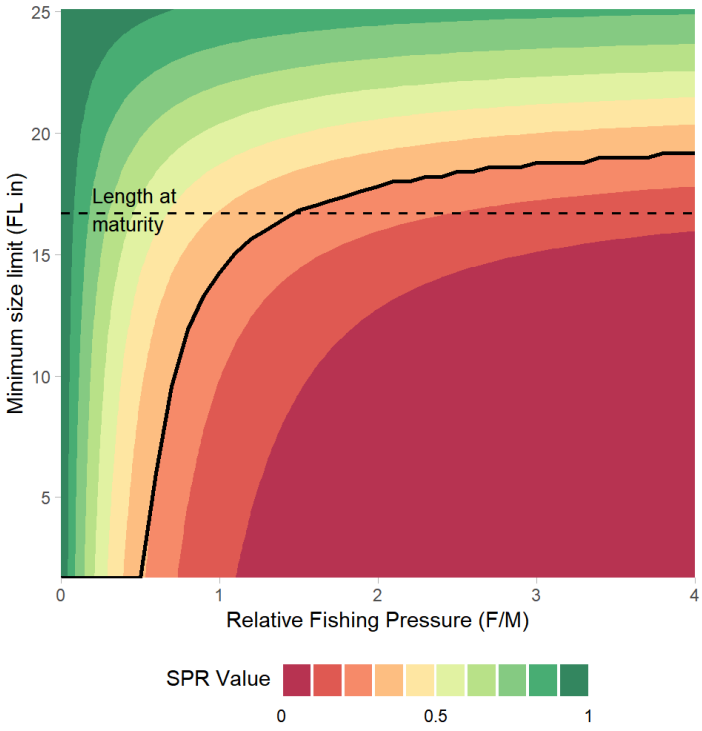
Albula glossodonta - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	382	15.0	**0.79**	**0.90**	**0.95**
1 x Lm	424	16.7	**0.77**	**0.92**	**1.00**
1.1 x Lm	466	18.3	**0.73**	**0.90**	**1.00**
1.2 x Lm	509	20.0	**0.64**	**0.82**	**0.97**
1.3 x Lm	551	21.7	**0.53**	**0.70**	**0.85**
1.5 x Lm	636	25.0	**0.24**	**0.34**	**0.45**
Current size limit	356	14.0	**0.79**	**0.88**	**0.90**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Albula glossodonta

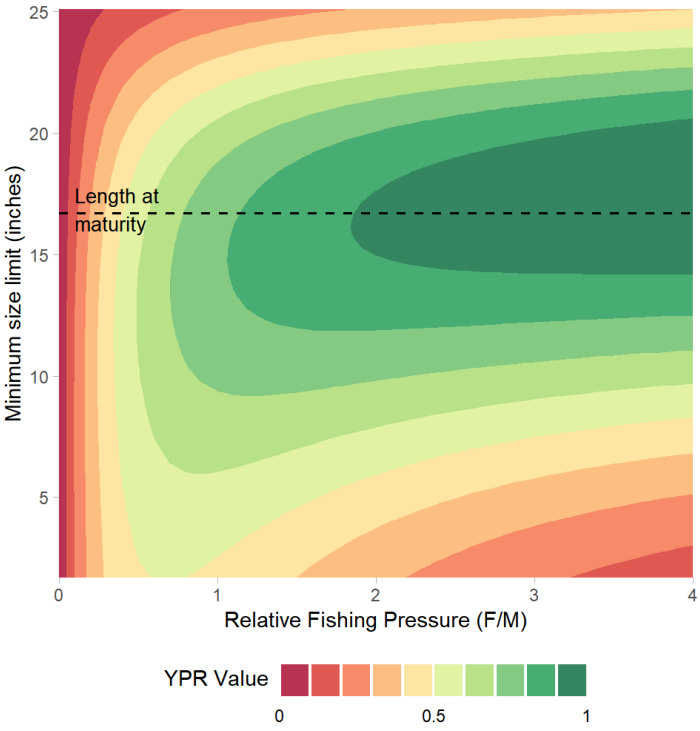
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Albula glossodonta

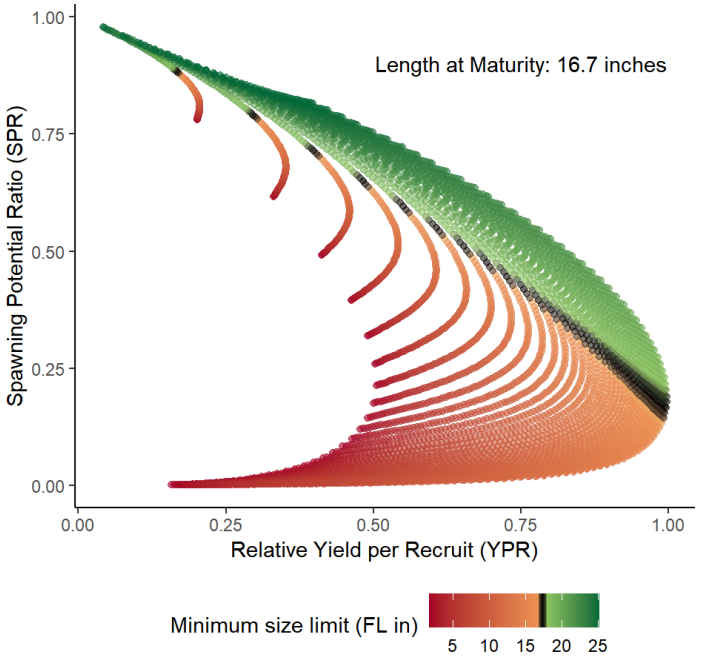
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Albula glossodonta

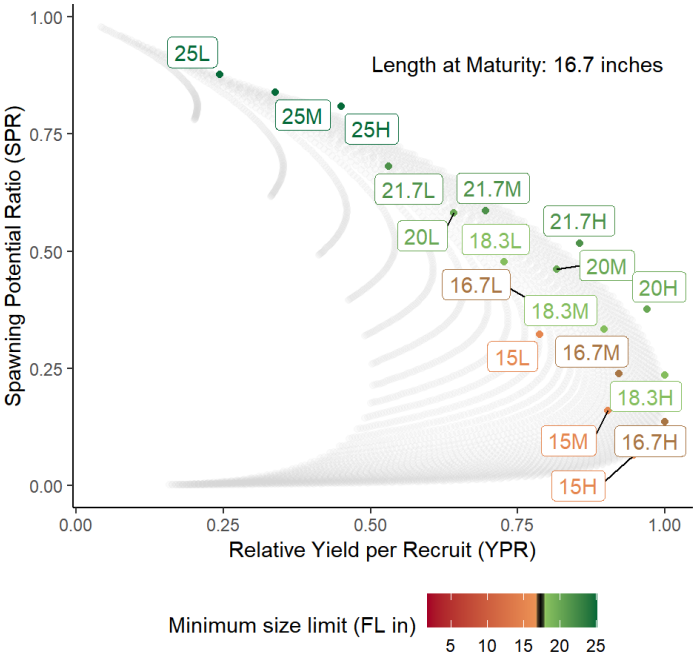
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Albula glossodonta

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Albula virgata**

Hawaiian Name: ‘O’io

Common Name: Longjaw Bonefish

Family: Bonefishes

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 564 mm FL

K (von Bertalanffy growth parameter): 0.26 per year

t0 (von Bertalanffy parameter): -0.49

Lm (Length at maturity): 432 mm FL

Lm (Length at maturity): 17 inches FL

M (natural mortality rate): 0.29 per year

Longevity: 11 years

M/K: 1.12

Lm/Loo: 0.77

Albula virgata - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	389	15.3	**0.33**	**0.17**	**0.07**
1 x Lm	432	17.0	**0.44**	**0.29**	**0.19**
1.1 x Lm	475	18.7	**0.60**	**0.48**	**0.40**
1.2 x Lm	518	20.4	**0.77**	**0.70**	**0.64**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

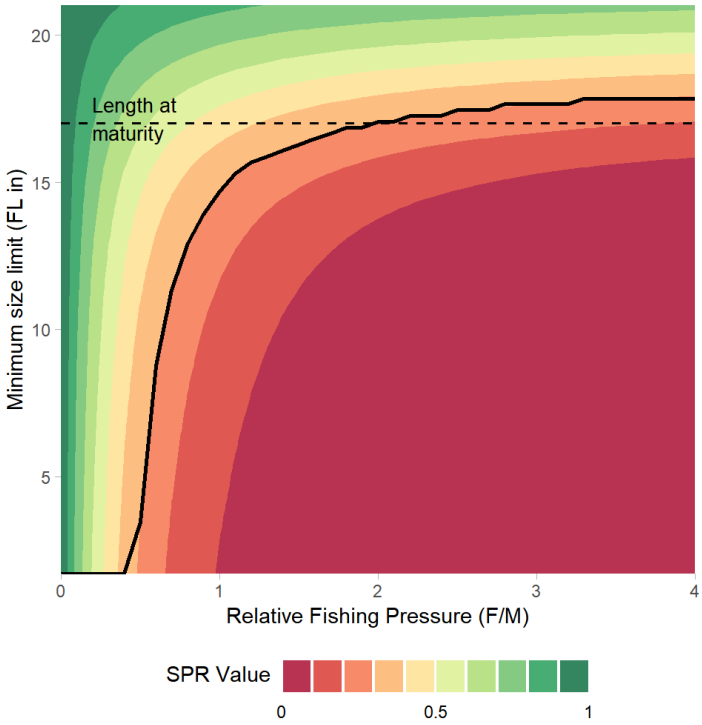
Albula virgata - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	389	15.3	**0.72**	**0.89**	**1.00**
1 x Lm	432	17.0	**0.64**	**0.81**	**0.96**
1.1 x Lm	475	18.7	**0.51**	**0.67**	**0.84**
1.2 x Lm	518	20.4	**0.32**	**0.44**	**0.57**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Albula virgata

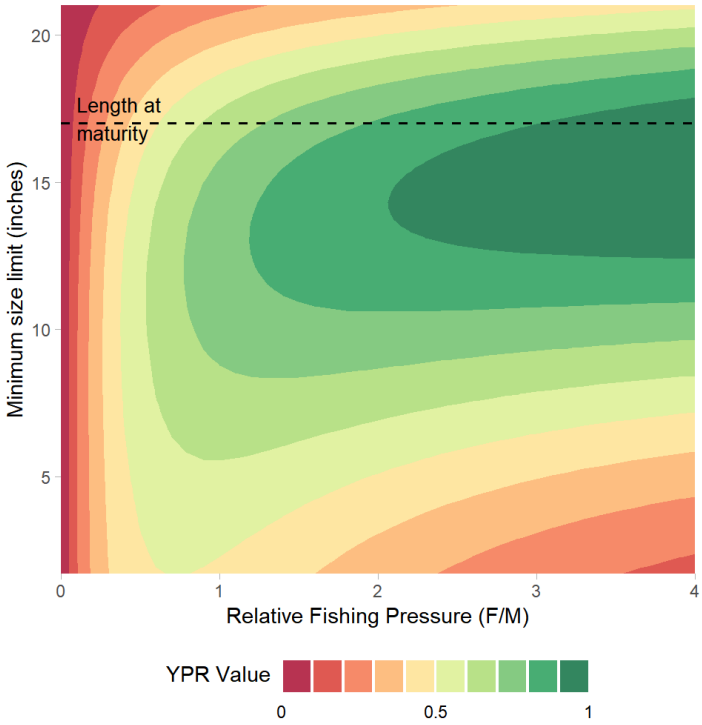
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Albula virgata

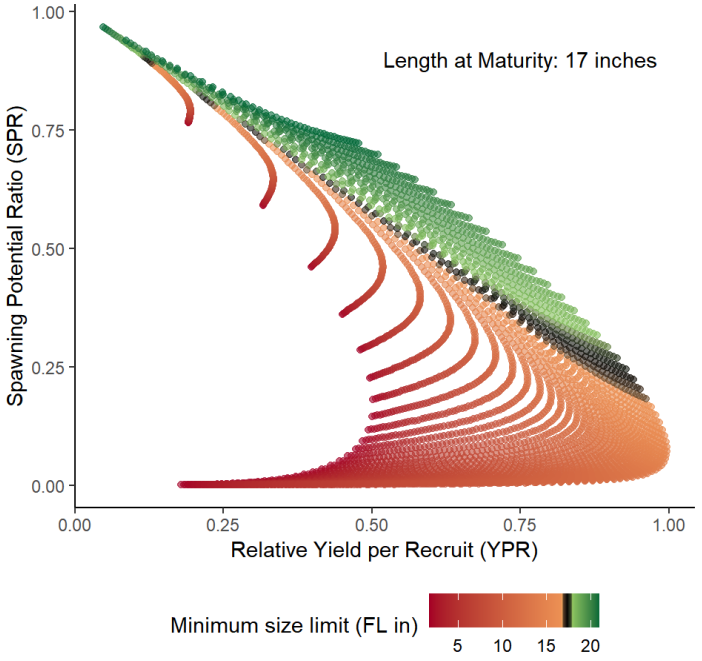
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Albula virgata

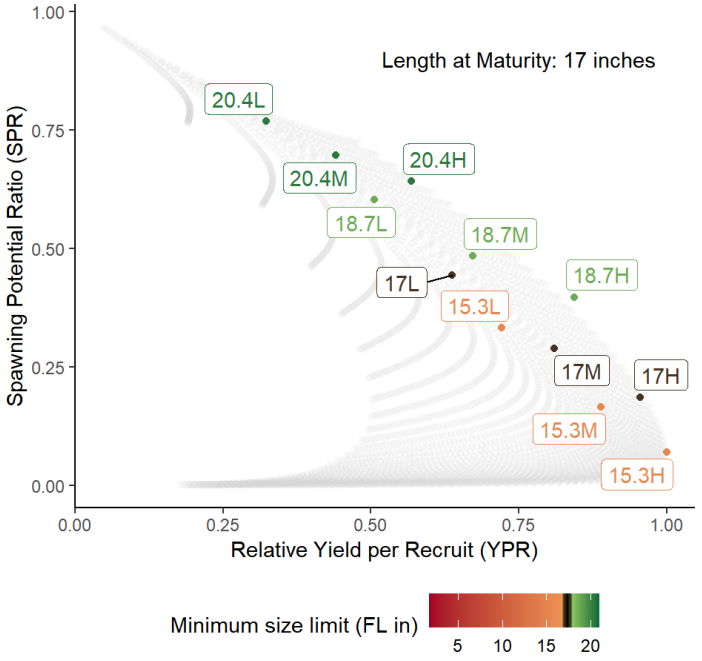
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Albula virgata

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Carangidae - Jacks

Species: **Caranx ignobilis**

Hawaiian Name: Ulua aukea

Common Name: Giant Trevally

Family: Jacks

Current Minimum Size Limit (FL): 10 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 1944 mm FL

K (von Bertalanffy growth parameter): 0.111 per year

t0 (von Bertalanffy parameter): 0.097

Lm (Length at maturity): 740 mm FL

Lm (Length at maturity): 29 inches FL

M (natural mortality rate): 0.29 per year

Longevity: 11 years

M/K: 2.61

Lm/Loo: 0.38

Caranx ignobilis - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	666	26.2	**0.27**	**0.12**	**0.05**
1 x Lm	740	29.1	**0.31**	**0.17**	**0.09**
1.1 x Lm	814	32.0	**0.36**	**0.22**	**0.14**
1.2 x Lm	888	35.0	**0.42**	**0.28**	**0.20**
1.3 x Lm	962	37.9	**0.47**	**0.35**	**0.27**
1.5 x Lm	1110	43.7	**0.59**	**0.49**	**0.42**
2 x Lm	1480	58.3	**0.85**	**0.81**	**0.78**
Current size limit	254	10.0	**0.13**	**0.03**	**0.00**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

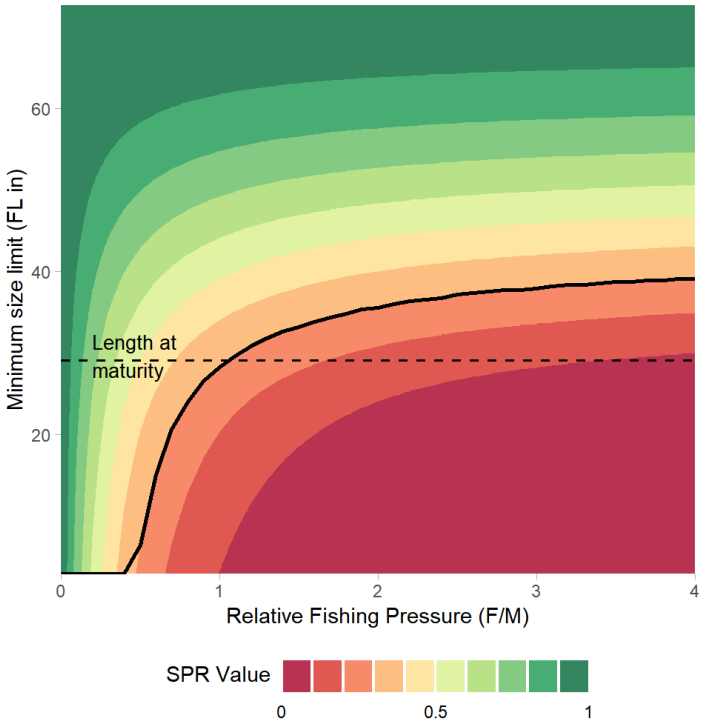
Caranx ignobilis - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	666	26.2	**0.82**	**0.85**	**0.82**
1 x Lm	740	29.1	**0.83**	**0.90**	**0.90**
1.1 x Lm	814	32.0	**0.83**	**0.93**	**0.95**
1.2 x Lm	888	35.0	**0.82**	**0.93**	**0.98**
1.3 x Lm	962	37.9	**0.79**	**0.92**	**0.99**
1.5 x Lm	1110	43.7	**0.70**	**0.85**	**0.95**
2 x Lm	1480	58.3	**0.32**	**0.41**	**0.49**
Current size limit	254	10.0	**0.56**	**0.42**	**0.27**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Caranx ignobilis

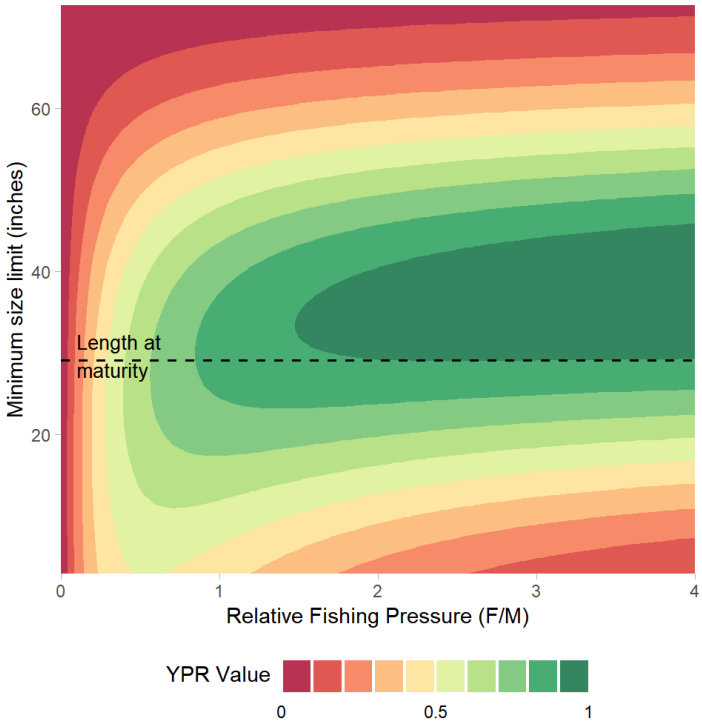
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Caranx ignobilis

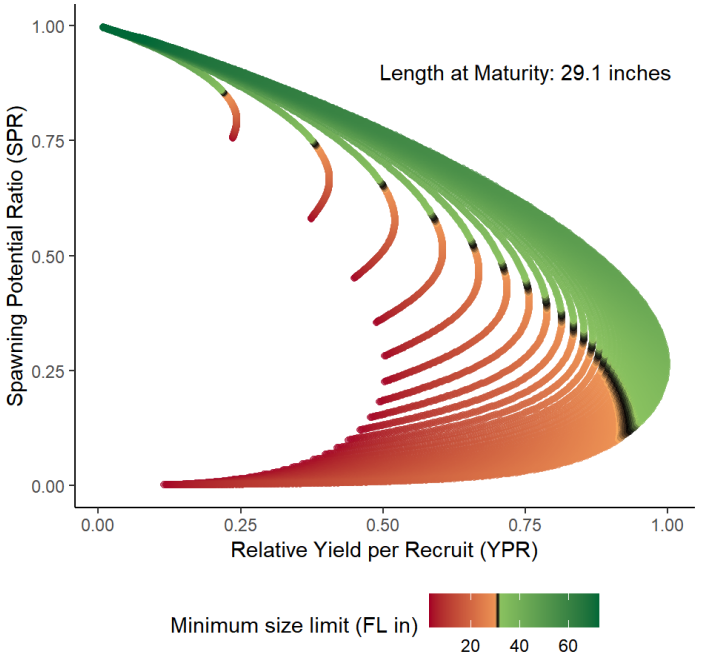
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Caranx ignobilis

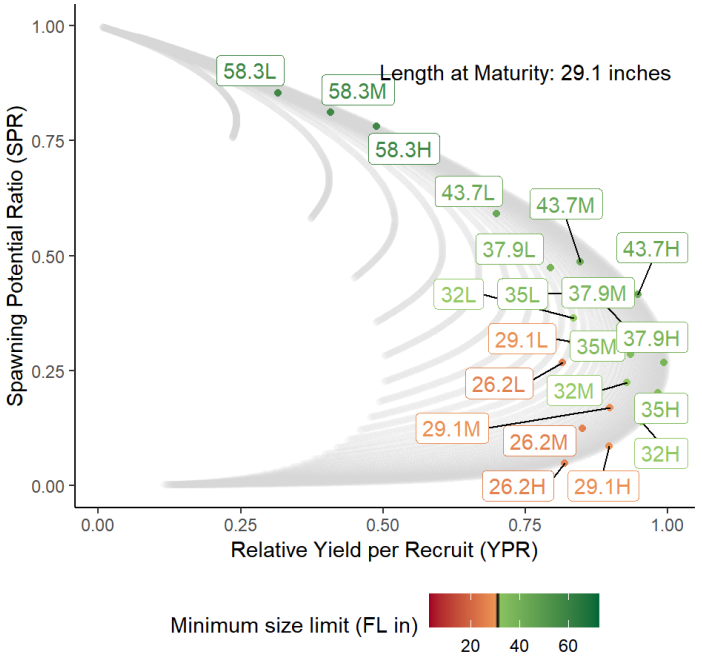
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Caranx ignobilis

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Caranx lugubris**

Hawaiian Name: Ulua la'uli

Common Name: Black Trevally

Family: Jacks

Current Minimum Size Limit (FL): 10 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 822 mm FL

K (von Bertalanffy growth parameter): 0.12 per year

t0 (von Bertalanffy parameter): 0

Lm (Length at maturity): 370 mm FL

Lm (Length at maturity): 15 inches FL

M (natural mortality rate): 0.27 per year

Longevity: 12 years

M/K: 2.25

Lm/Loo: 0.45

Caranx lugubris - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	333	13.1	**0.28**	**0.14**	**0.05**
1 x Lm	370	14.6	**0.34**	**0.19**	**0.10**
1.1 x Lm	407	16.0	**0.40**	**0.25**	**0.16**
1.2 x Lm	444	17.5	**0.46**	**0.33**	**0.25**
1.3 x Lm	481	18.9	**0.53**	**0.41**	**0.33**
1.5 x Lm	555	21.9	**0.67**	**0.58**	**0.52**
2 x Lm	740	29.1	**0.94**	**0.92**	**0.91**
Current size limit	254	10.0	**0.20**	**0.07**	**0.01**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

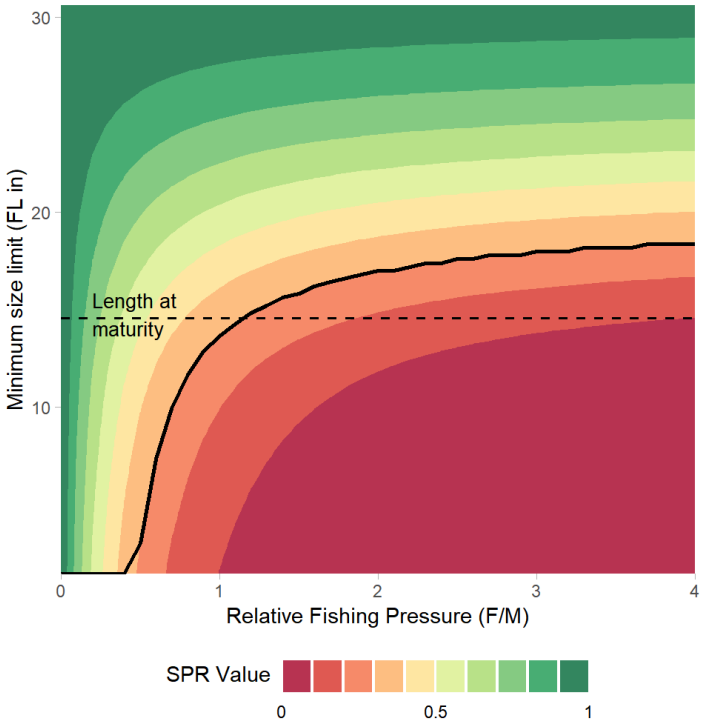
Caranx lugubris - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	333	13.1	**0.80**	**0.86**	**0.86**
1 x Lm	370	14.6	**0.81**	**0.90**	**0.95**
1.1 x Lm	407	16.0	**0.79**	**0.92**	**0.98**
1.2 x Lm	444	17.5	**0.77**	**0.91**	**1.00**
1.3 x Lm	481	18.9	**0.72**	**0.88**	**1.00**
1.5 x Lm	555	21.9	**0.58**	**0.74**	**0.88**
2 x Lm	740	29.1	**0.14**	**0.19**	**0.26**
Current size limit	254	10.0	**0.73**	**0.72**	**0.65**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Caranx lugubris

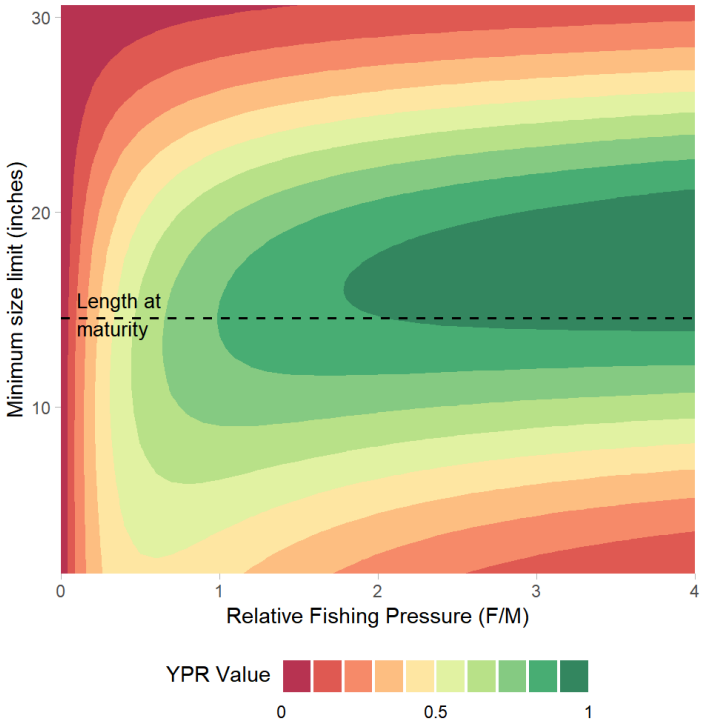
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Caranx lugubris

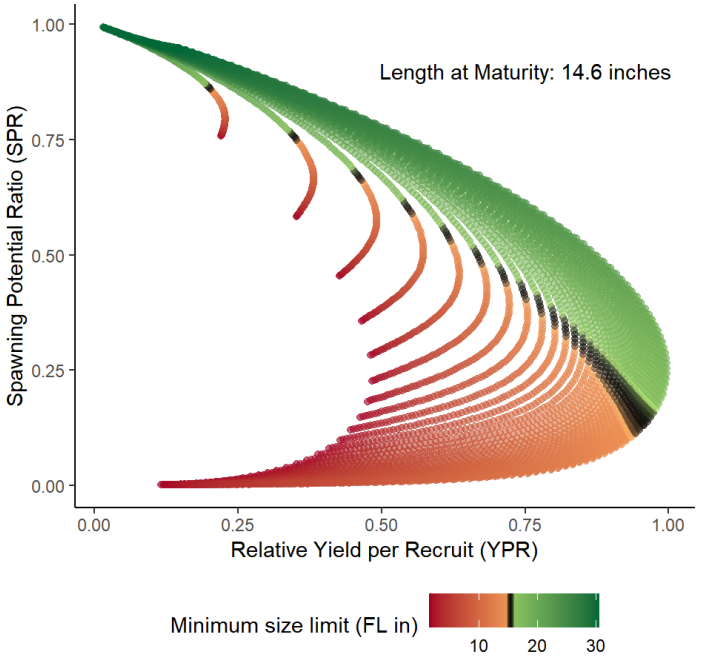
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Caranx lugubris

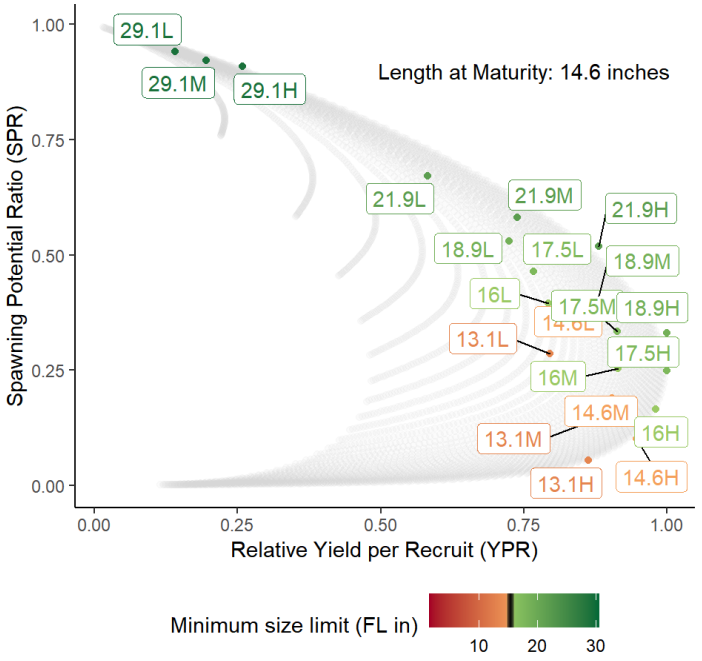
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Caranx lugubris

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Caranx melampygus**

Hawaiian Name: ‘Omilu

Common Name: Bluefin Trevally

Family: Jacks

Current Minimum Size Limit (FL): 10 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 1014 mm FL

K (von Bertalanffy growth parameter): 0.233 per year

t0 (von Bertalanffy parameter): -0.044

Lm (Length at maturity): 452 mm FL

Lm (Length at maturity): 18 inches FL

M (natural mortality rate): 0.46 per year

Longevity: 7 years

M/K: 1.97

Lm/Loo: 0.45

Caranx melampygus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	407	16.0	**0.29**	**0.14**	**0.05**
1 x Lm	452	17.8	**0.33**	**0.18**	**0.09**
1.1 x Lm	497	19.6	**0.38**	**0.24**	**0.15**
1.2 x Lm	542	21.3	**0.44**	**0.30**	**0.22**
1.3 x Lm	588	23.1	**0.51**	**0.38**	**0.30**
1.5 x Lm	678	26.7	**0.63**	**0.54**	**0.47**
2 x Lm	904	35.6	**0.92**	**0.89**	**0.87**
Current size limit	254	10.0	**0.18**	**0.06**	**0.01**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

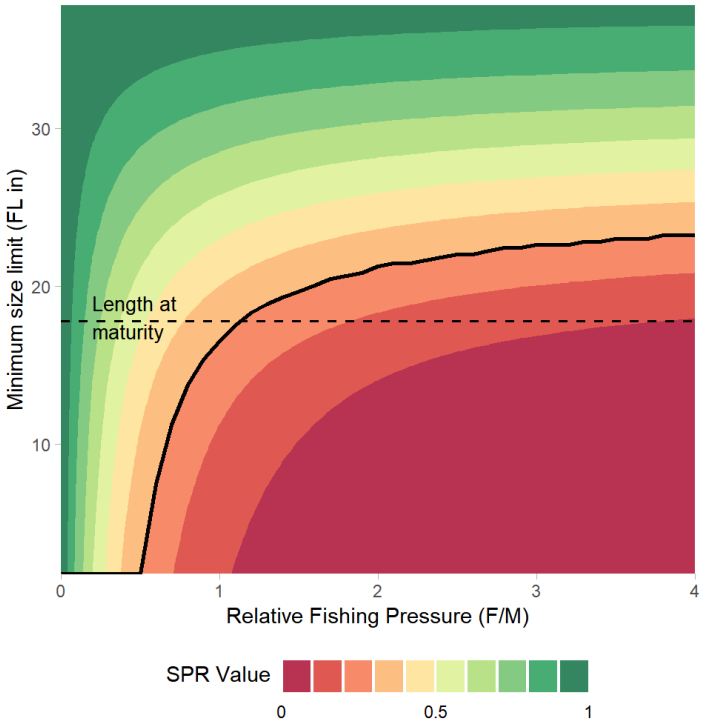
Caranx melampygus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	407	16.0	**0.79**	**0.83**	**0.81**
1 x Lm	452	17.8	**0.80**	**0.88**	**0.89**
1.1 x Lm	497	19.6	**0.80**	**0.91**	**0.95**
1.2 x Lm	542	21.3	**0.78**	**0.91**	**0.98**
1.3 x Lm	588	23.1	**0.75**	**0.89**	**0.98**
1.5 x Lm	678	26.7	**0.63**	**0.78**	**0.90**
2 x Lm	904	35.6	**0.19**	**0.26**	**0.33**
Current size limit	254	10.0	**0.66**	**0.60**	**0.48**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Caranx melampygus

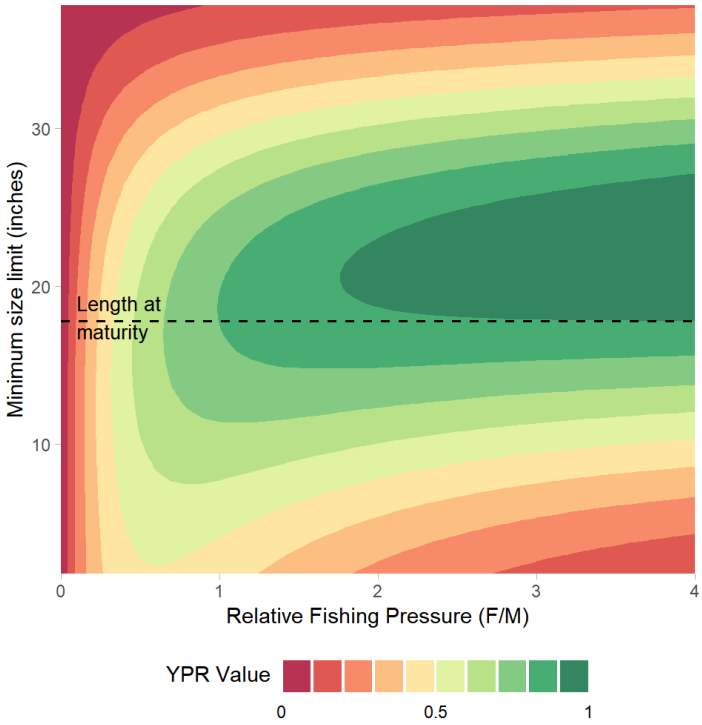
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Caranx melampygus

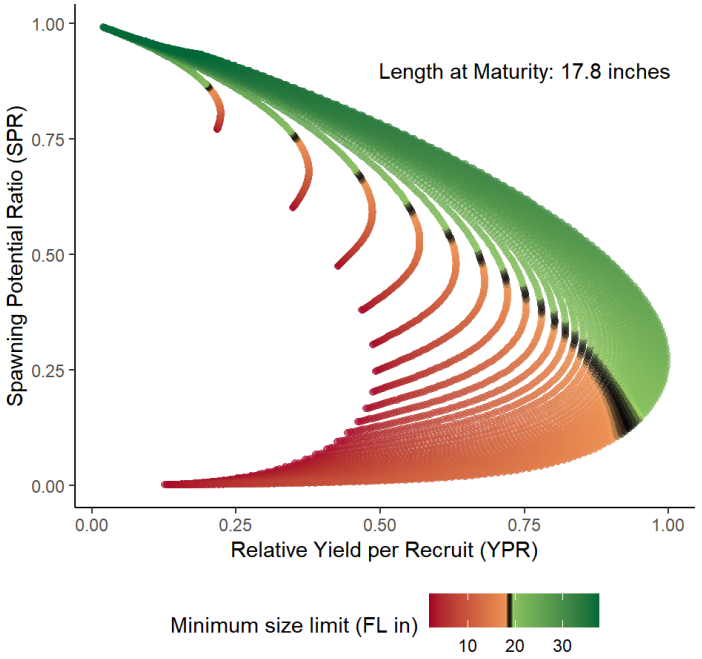
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Caranx melampygus

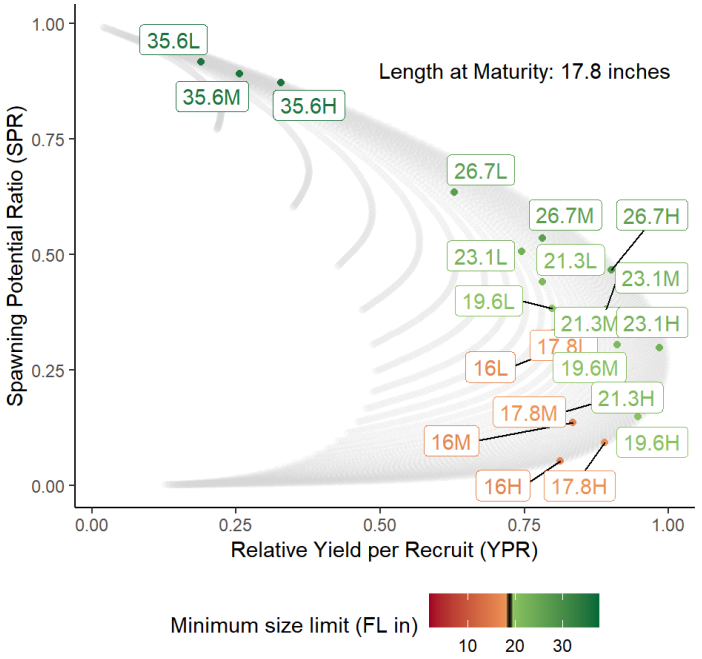
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Caranx melampygus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Caranx sexfasciatus**

Hawaiian Name: Pake ulua

Common Name: Bigeye Trevally

Family: Jacks

Current Minimum Size Limit (FL): 10 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 800 mm FL

K (von Bertalanffy growth parameter): 0.24 per year

t0 (von Bertalanffy parameter): 0

Lm (Length at maturity): 455 mm FL

Lm (Length at maturity): 18 inches FL

M (natural mortality rate): 0.29 per year

Longevity: 11 years

M/K: 1.21

Lm/Loo: 0.57

Caranx sexfasciatus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	410	16.1	**0.32**	**0.16**	**0.07**
1 x Lm	455	17.9	**0.37**	**0.21**	**0.11**
1.1 x Lm	501	19.7	**0.43**	**0.28**	**0.18**
1.2 x Lm	546	21.5	**0.50**	**0.37**	**0.27**
1.3 x Lm	592	23.3	**0.58**	**0.46**	**0.38**
1.5 x Lm	682	26.9	**0.75**	**0.67**	**0.62**
Current size limit	254	10.0	**0.21**	**0.07**	**0.01**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

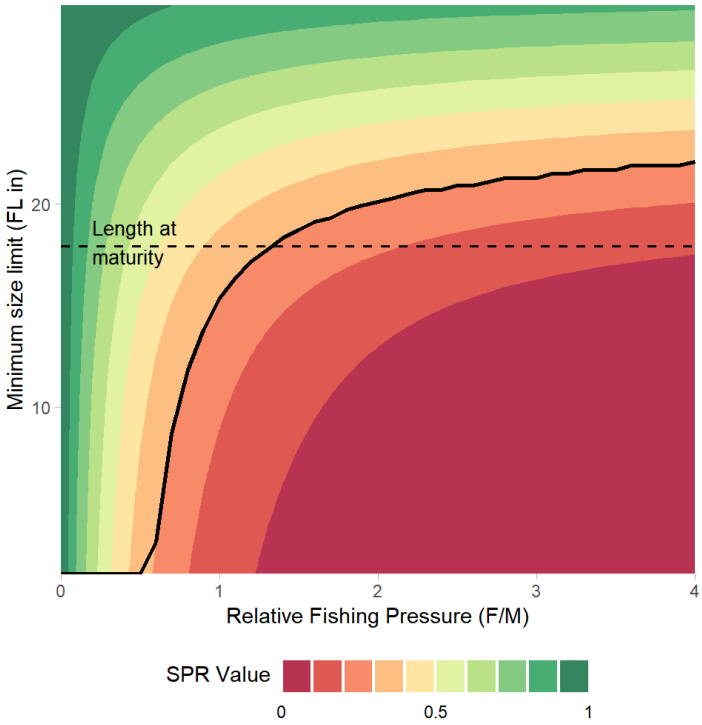
Caranx sexfasciatus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	410	16.1	**0.77**	**0.86**	**0.86**
1 x Lm	455	17.9	**0.78**	**0.89**	**0.94**
1.1 x Lm	501	19.7	**0.76**	**0.91**	**0.98**
1.2 x Lm	546	21.5	**0.73**	**0.89**	**1.00**
1.3 x Lm	592	23.3	**0.66**	**0.83**	**0.95**
1.5 x Lm	682	26.9	**0.45**	**0.60**	**0.73**
Current size limit	254	10.0	**0.67**	**0.63**	**0.51**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Caranx sexfasciatus

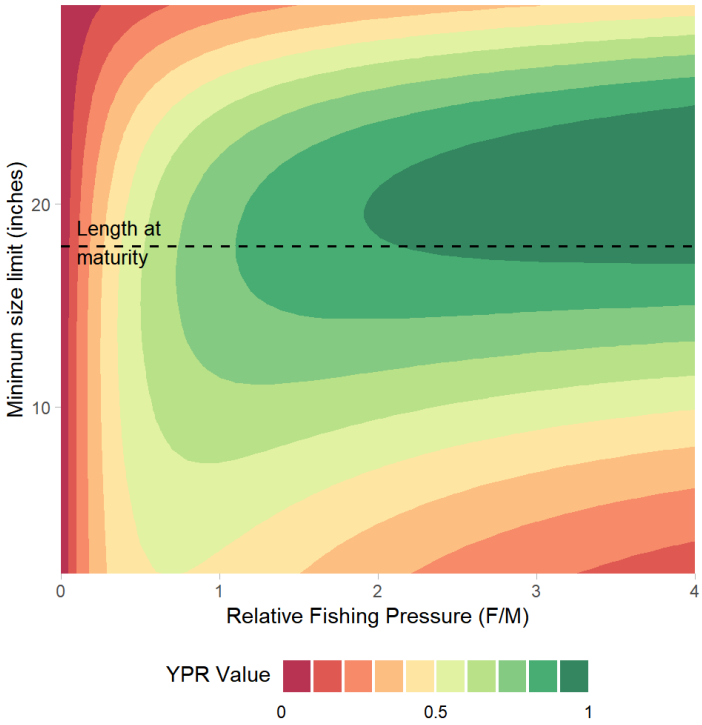
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Caranx sexfasciatus

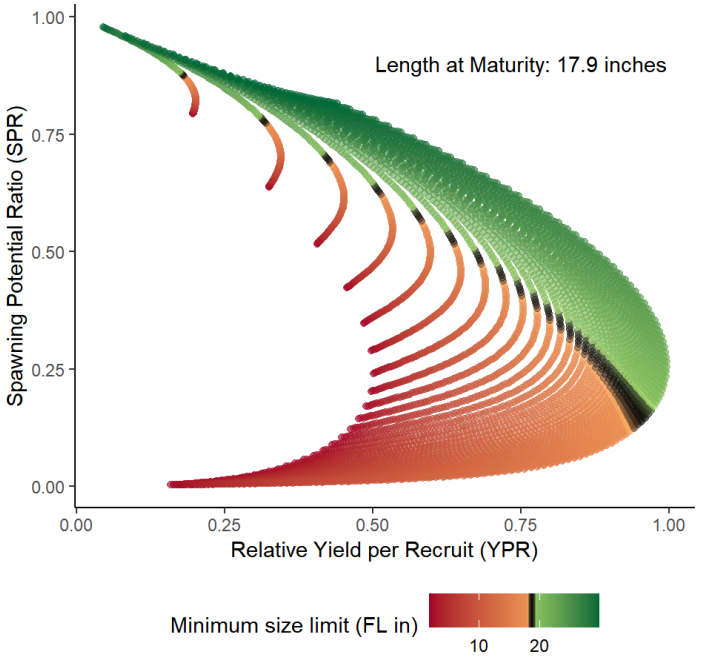
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Caranx sexfasciatus

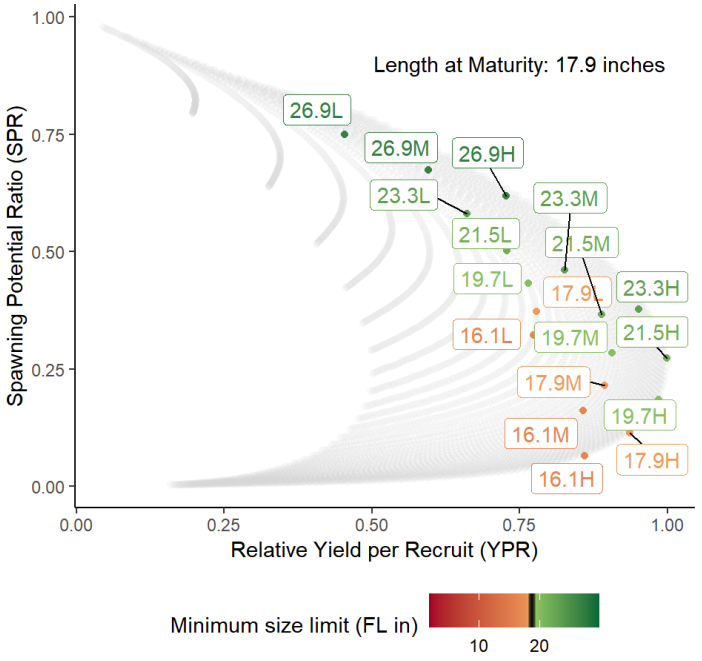
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Caranx sexfasciatus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Elagatis bipinnulata**

Hawaiian Name: Kamanu

Common Name: Rainbow Runner

Family: Jacks

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 930 mm FL

K (von Bertalanffy growth parameter): 0.214 per year

t0 (von Bertalanffy parameter): 0

Lm (Length at maturity): 640 mm FL

Lm (Length at maturity): 25 inches FL

M (natural mortality rate): 0.25 per year

Longevity: 13 years

M/K: 1.17

Lm/Loo: 0.69

Elagatis bipinnulata - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	576	22.7	**0.33**	**0.17**	**0.07**
1 x Lm	640	25.2	**0.42**	**0.26**	**0.15**
1.1 x Lm	704	27.7	**0.52**	**0.39**	**0.29**
1.2 x Lm	768	30.2	**0.65**	**0.54**	**0.46**
1.3 x Lm	832	32.8	**0.77**	**0.69**	**0.64**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

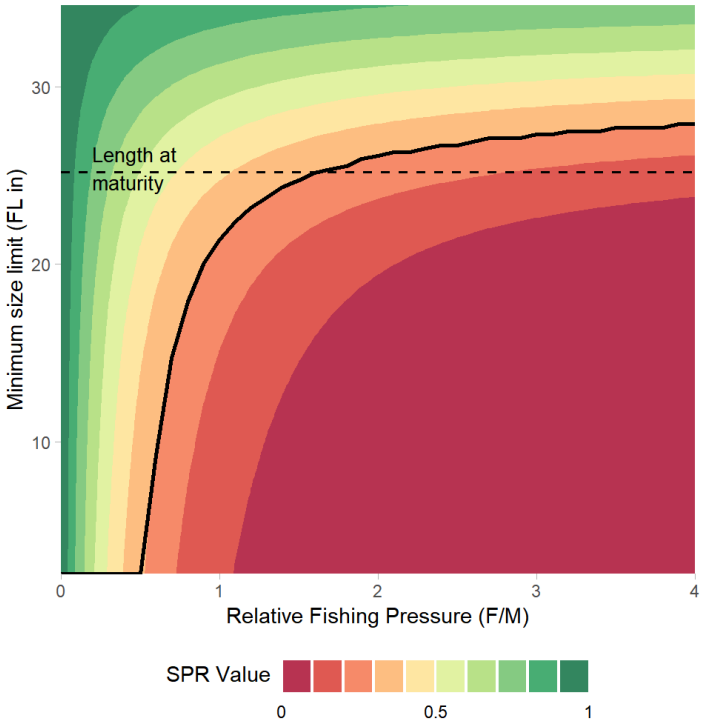
Elagatis bipinnulata - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	576	22.7	**0.77**	**0.91**	**0.98**
1 x Lm	640	25.2	**0.73**	**0.89**	**1.00**
1.1 x Lm	704	27.7	**0.65**	**0.82**	**0.95**
1.2 x Lm	768	30.2	**0.52**	**0.67**	**0.80**
1.3 x Lm	832	32.8	**0.37**	**0.49**	**0.61**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Elagatis bipinnulata

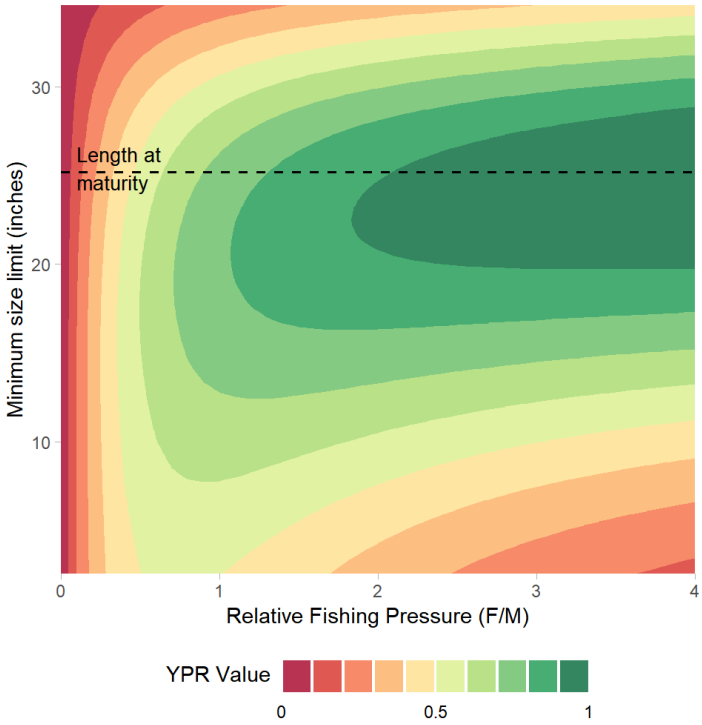
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Elagatis bipinnulata

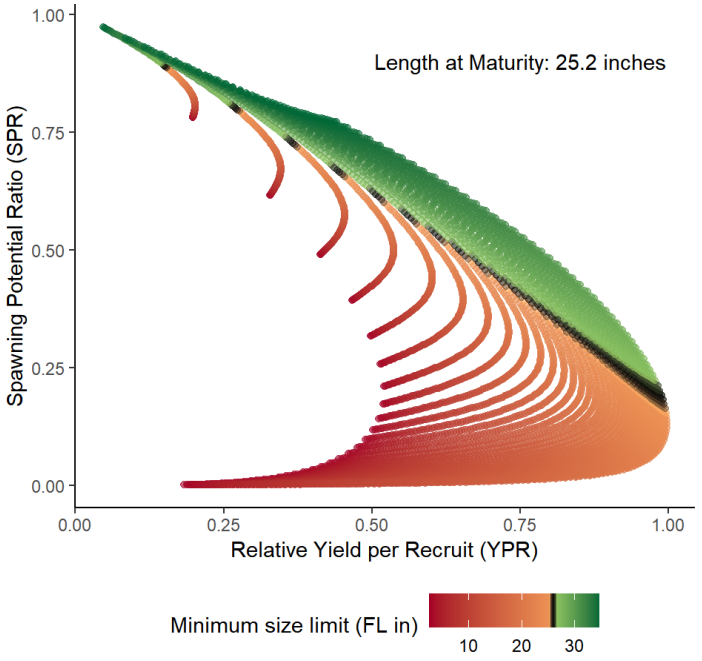
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Elagatis bipinnulata

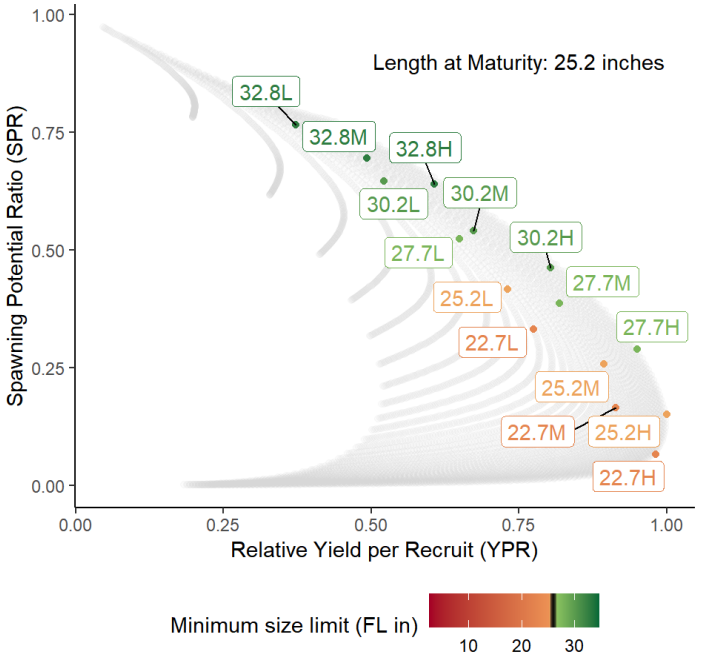
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Elagatis bipinnulata

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Pseudocaranx dentex**

Hawaiian Name: Butaguchi

Common Name: Thick Lipped Jack

Family: Jacks

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 1232 mm FL

K (von Bertalanffy growth parameter): 0.307 per year

t0 (von Bertalanffy parameter): -0.77

Lm (Length at maturity): 260 mm FL

Lm (Length at maturity): 10 inches FL

M (natural mortality rate): 0.46 per year

Longevity: 7 years

M/K: 1.5

Lm/Loo: 0.21

Pseudocaranx dentex - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	234	9.2	**0.23**	**0.09**	**0.03**
1 x Lm	260	10.2	**0.24**	**0.10**	**0.04**
1.1 x Lm	286	11.3	**0.25**	**0.11**	**0.04**
1.2 x Lm	312	12.3	**0.26**	**0.12**	**0.05**
1.3 x Lm	338	13.3	**0.27**	**0.13**	**0.06**
1.5 x Lm	390	15.4	**0.29**	**0.15**	**0.07**
2 x Lm	520	20.5	**0.36**	**0.22**	**0.14**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

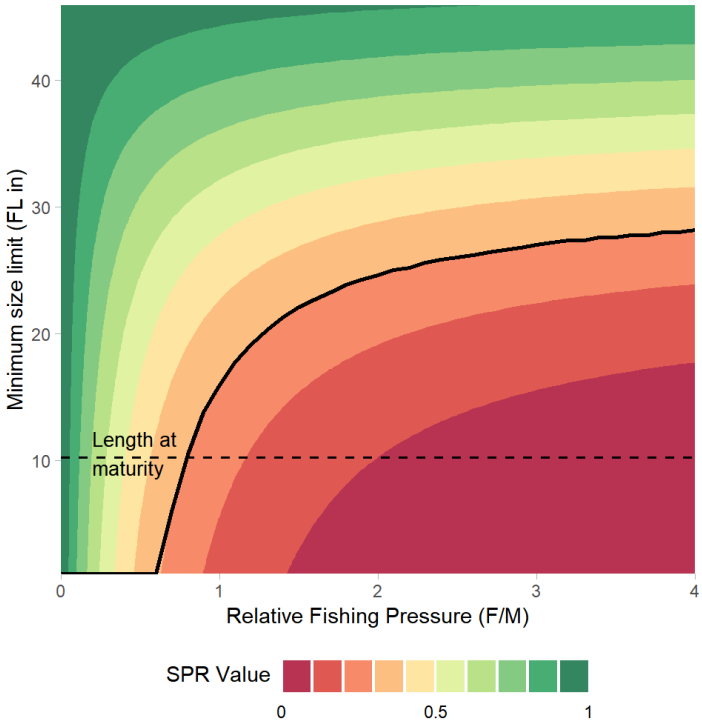
Pseudocaranx dentex - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	234	9.2	**0.60**	**0.49**	**0.33**
1 x Lm	260	10.2	**0.62**	**0.52**	**0.37**
1.1 x Lm	286	11.3	**0.64**	**0.55**	**0.41**
1.2 x Lm	312	12.3	**0.66**	**0.58**	**0.45**
1.3 x Lm	338	13.3	**0.68**	**0.62**	**0.49**
1.5 x Lm	390	15.4	**0.71**	**0.68**	**0.58**
2 x Lm	520	20.5	**0.78**	**0.83**	**0.79**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Pseudocaranx dentex

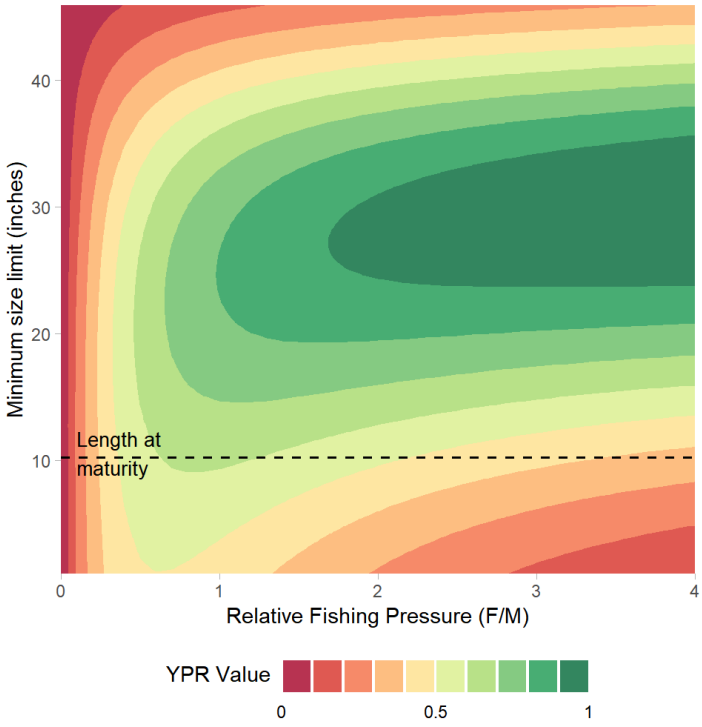
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Pseudocaranx dentex

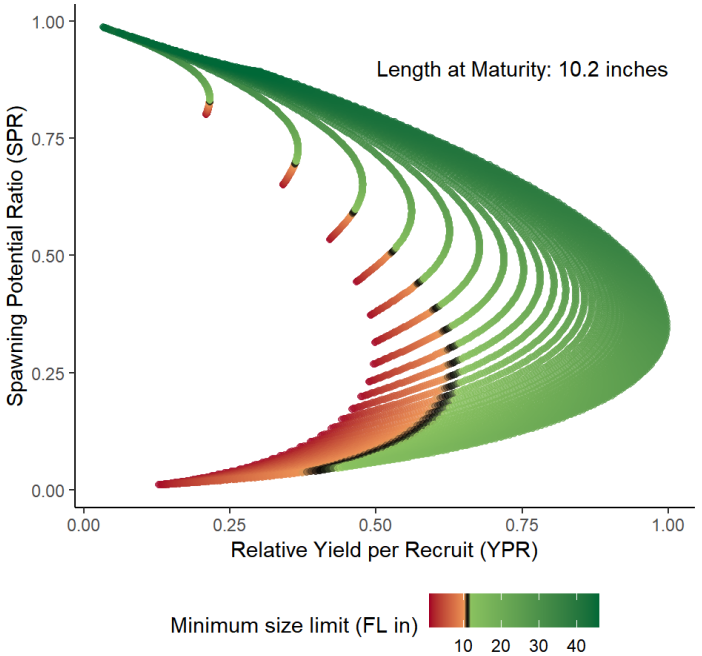
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Pseudocaranx dentex

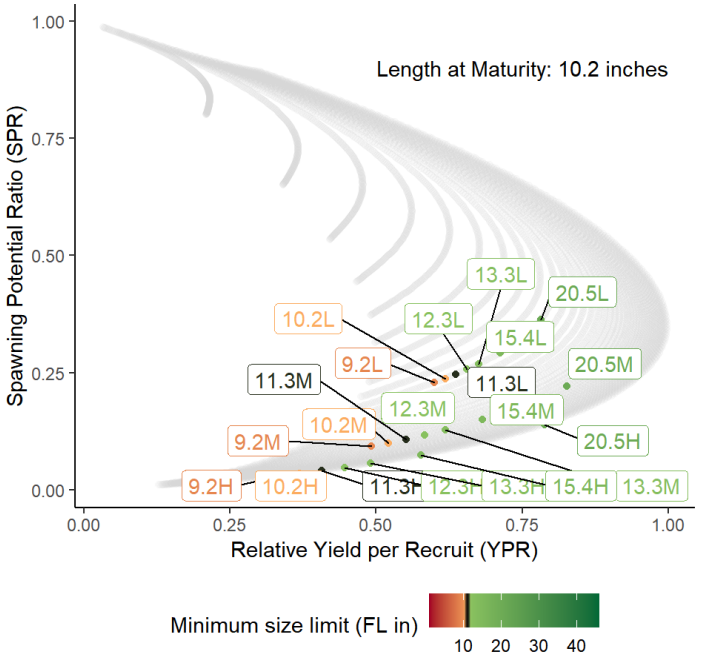
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Pseudocaranx dentex

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Seriola dumerili**

Hawaiian Name: Kahala

Common Name: Greater Amberjack

Family: Jacks

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 1118 mm FL

K (von Bertalanffy growth parameter): 0.2272 per year

t0 (von Bertalanffy parameter): -0.7931

Lm (Length at maturity): 799 mm FL

Lm (Length at maturity): 31 inches FL

M (natural mortality rate): 0.21 per year

Longevity: 15 years

M/K: 0.92

Lm/Loo: 0.71

Seriola dumerili - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	719	28.3	**0.35**	**0.18**	**0.07**
1 x Lm	799	31.5	**0.43**	**0.27**	**0.16**
1.1 x Lm	879	34.6	**0.53**	**0.39**	**0.29**
1.2 x Lm	959	37.8	**0.66**	**0.55**	**0.47**
1.3 x Lm	1039	40.9	**0.79**	**0.72**	**0.67**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

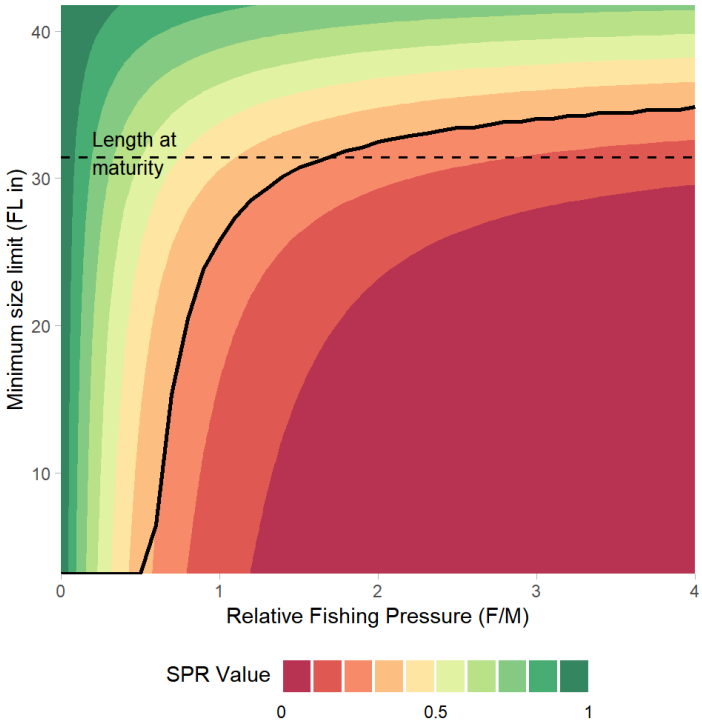
Seriola dumerili - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	719	28.3	**0.77**	**0.92**	**0.98**
1 x Lm	799	31.5	**0.73**	**0.90**	**1.00**
1.1 x Lm	879	34.6	**0.65**	**0.82**	**0.95**
1.2 x Lm	959	37.8	**0.51**	**0.67**	**0.80**
1.3 x Lm	1039	40.9	**0.35**	**0.46**	**0.57**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Seriola dumerili

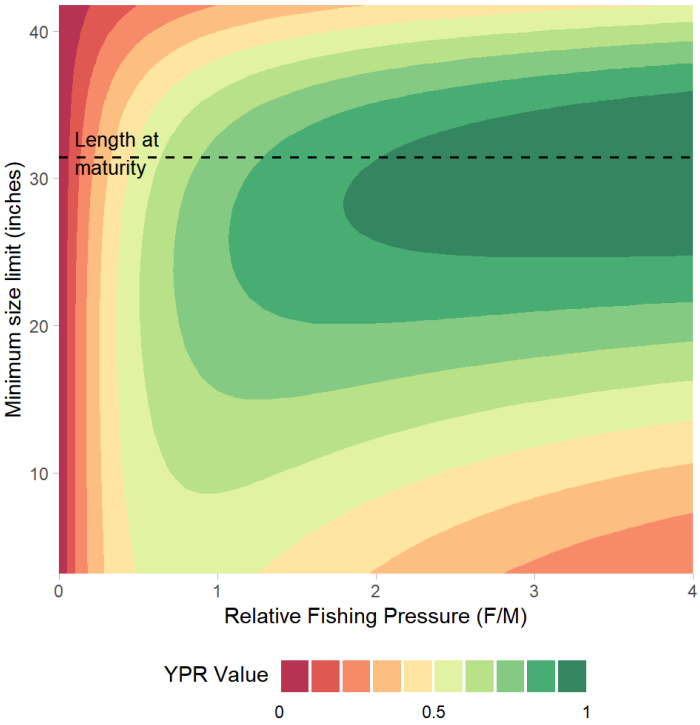
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Seriola dumerili

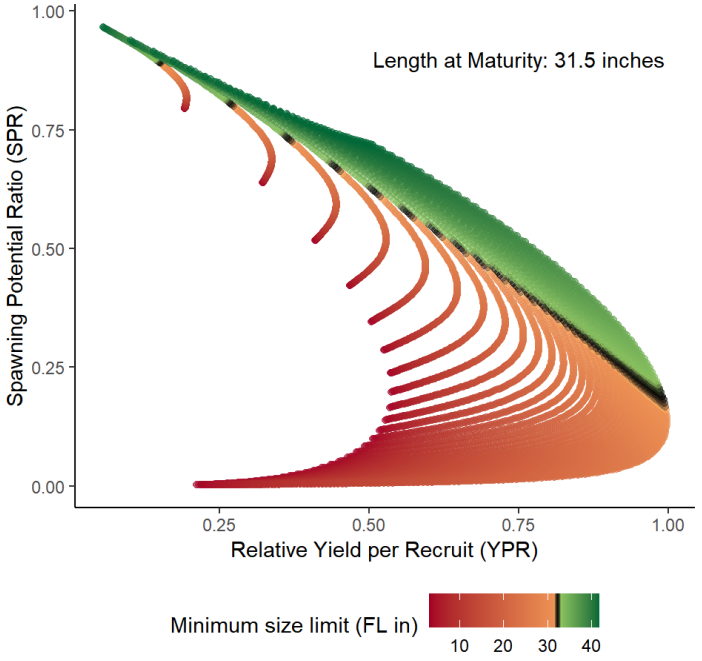
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Seriola dumerili

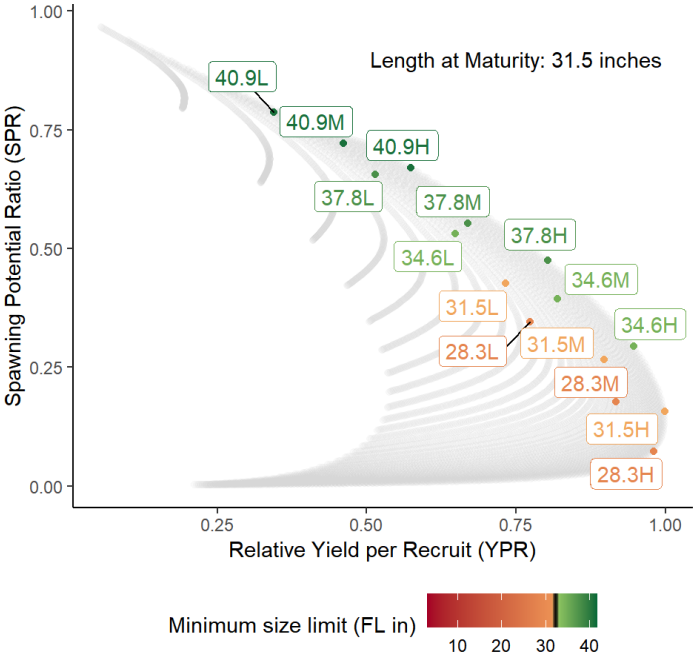
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Seriola dumerili

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Holocentridae - Squirrelfishes

Species: **Myripristis berndti**

Hawaiian Name: ‘U’u

Common Name: Bigscale Soldierfish

Family: Squirrelfishes

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 249 mm FL

K (von Bertalanffy growth parameter): 0.1475 per year

t0 (von Bertalanffy parameter): -4.4786

Lm (Length at maturity): 161 mm FL

Lm (Length at maturity): 6 inches FL

M (natural mortality rate): 0.12 per year

Longevity: 27 years

M/K: 0.81

Lm/Loo: 0.65

Myripristis berndti - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	145	5.7	**0.36**	**0.19**	**0.09**
1 x Lm	161	6.3	**0.41**	**0.25**	**0.14**
1.1 x Lm	177	7.0	**0.47**	**0.32**	**0.22**
1.2 x Lm	193	7.6	**0.56**	**0.43**	**0.34**
1.3 x Lm	209	8.2	**0.66**	**0.56**	**0.48**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

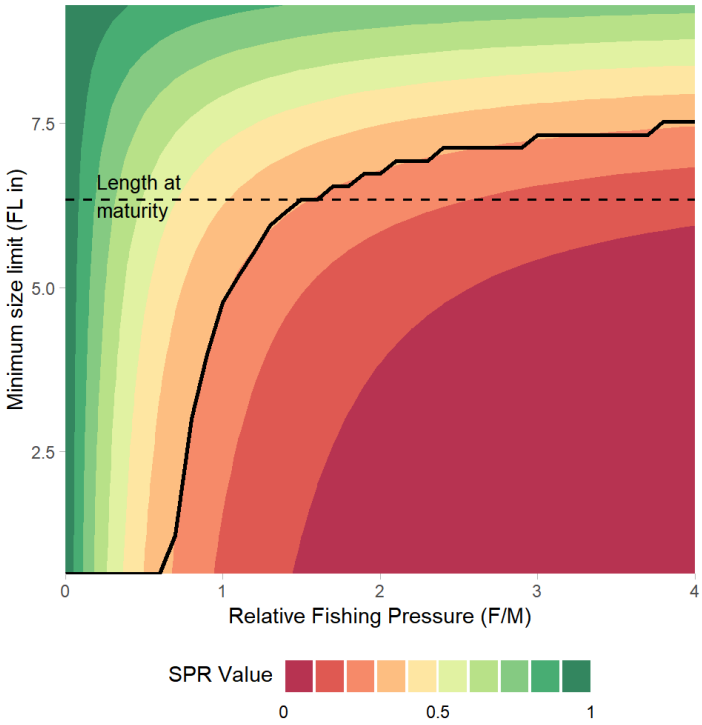
Myripristis berndti - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	145	5.7	**0.66**	**0.77**	**0.81**
1 x Lm	161	6.3	**0.66**	**0.80**	**0.89**
1.1 x Lm	177	7.0	**0.64**	**0.80**	**0.93**
1.2 x Lm	193	7.6	**0.60**	**0.78**	**0.96**
1.3 x Lm	209	8.2	**0.53**	**0.73**	**0.97**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Myripristis berndti

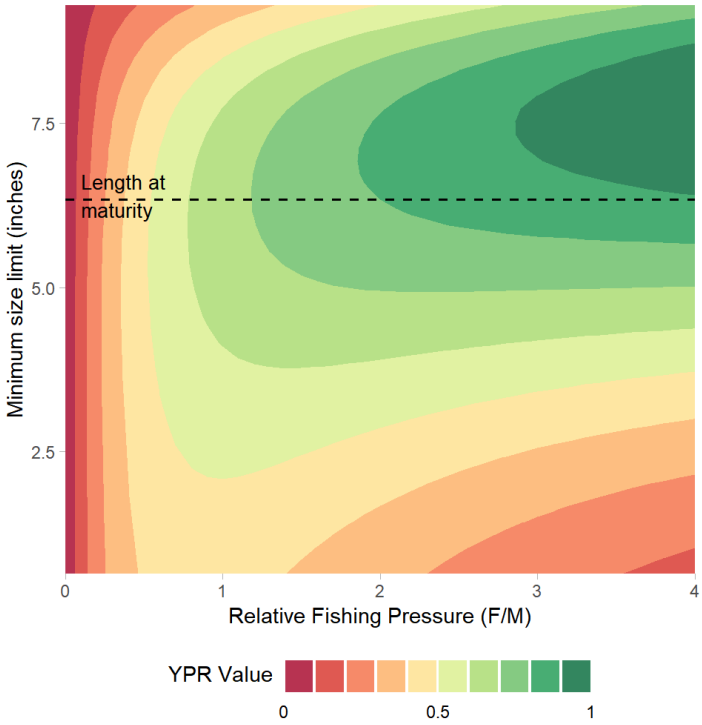
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Myripristis berndti

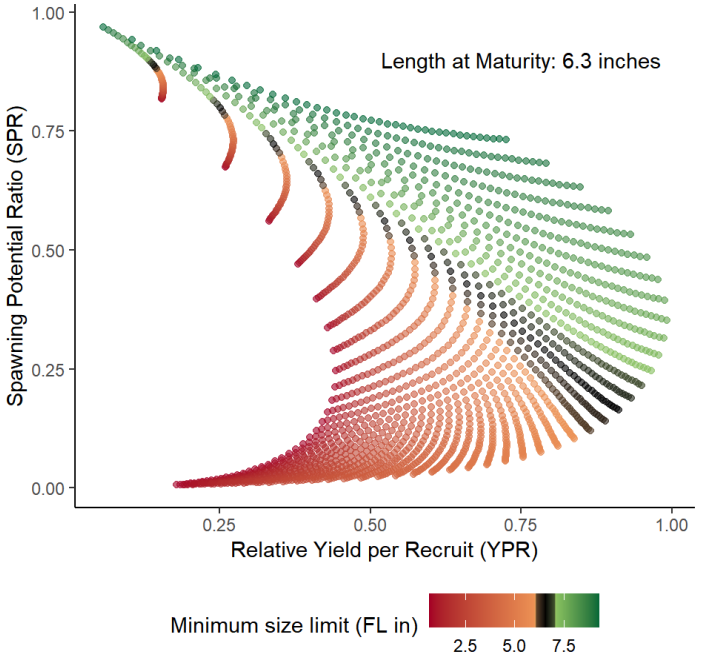
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Myripristis berndti

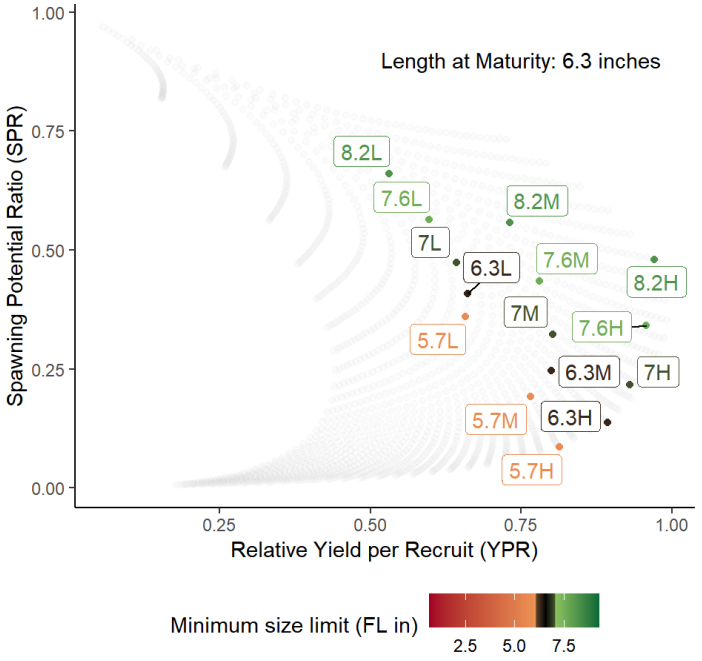
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Myripristis berndti

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Lutjanidae - Snappers

Species: **Aprion virescens**

Hawaiian Name: Uku

Common Name: Green Jobfish

Family: Snappers

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 765 mm FL

K (von Bertalanffy growth parameter): 0.136 per year

t0 (von Bertalanffy parameter): 0

Lm (Length at maturity): 450 mm FL

Lm (Length at maturity): 18 inches FL

M (natural mortality rate): 0.1 per year

Longevity: 32 years

M/K: 0.74

Lm/Loo: 0.59

Aprion virescens - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	405	15.9	**0.35**	**0.18**	**0.07**
1 x Lm	450	17.7	**0.38**	**0.22**	**0.11**
1.1 x Lm	495	19.5	**0.42**	**0.27**	**0.16**
1.2 x Lm	540	21.3	**0.48**	**0.33**	**0.22**
1.3 x Lm	585	23.0	**0.54**	**0.40**	**0.30**
1.5 x Lm	675	26.6	**0.70**	**0.61**	**0.54**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

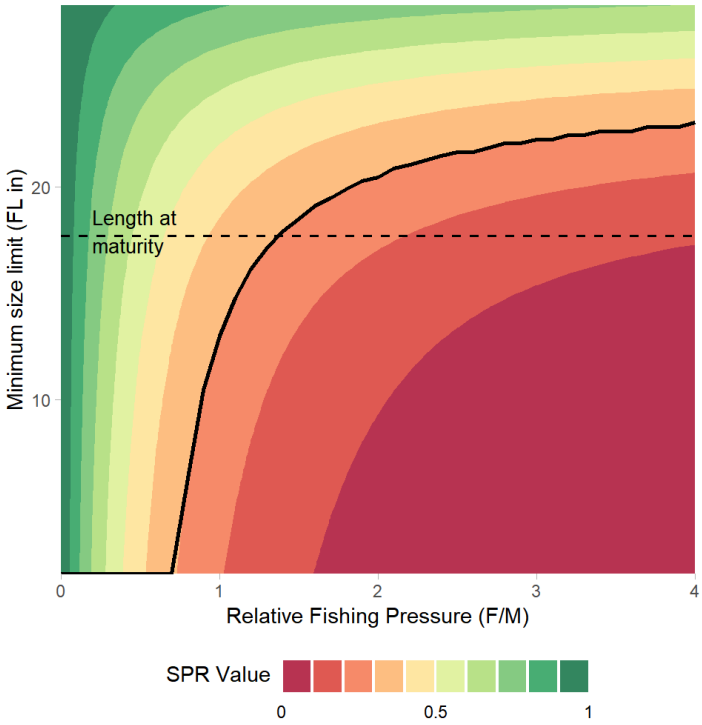
Aprion virescens - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	405	15.9	**0.74**	**0.81**	**0.77**
1 x Lm	450	17.7	**0.75**	**0.85**	**0.86**
1.1 x Lm	495	19.5	**0.76**	**0.89**	**0.93**
1.2 x Lm	540	21.3	**0.75**	**0.90**	**0.98**
1.3 x Lm	585	23.0	**0.71**	**0.88**	**1.00**
1.5 x Lm	675	26.6	**0.53**	**0.70**	**0.86**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Aprion virescens

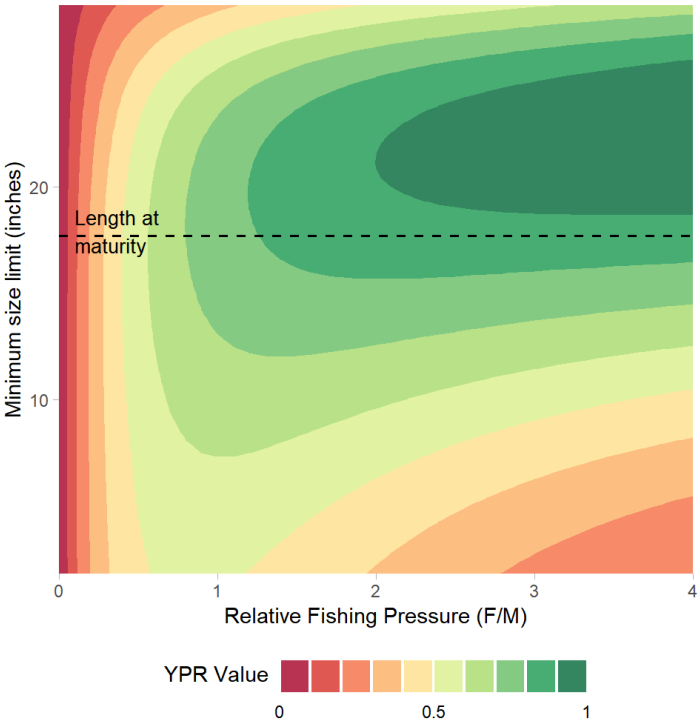
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Aprion virescens

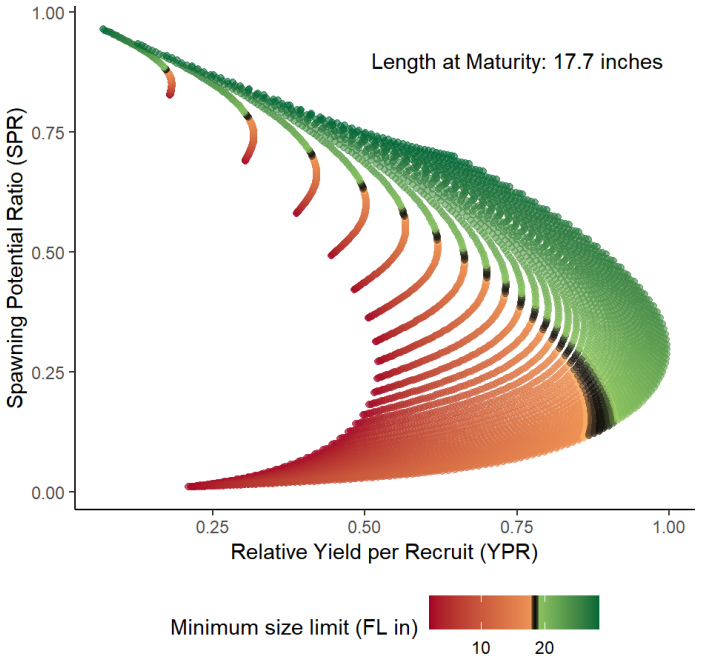
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Aprion virescens

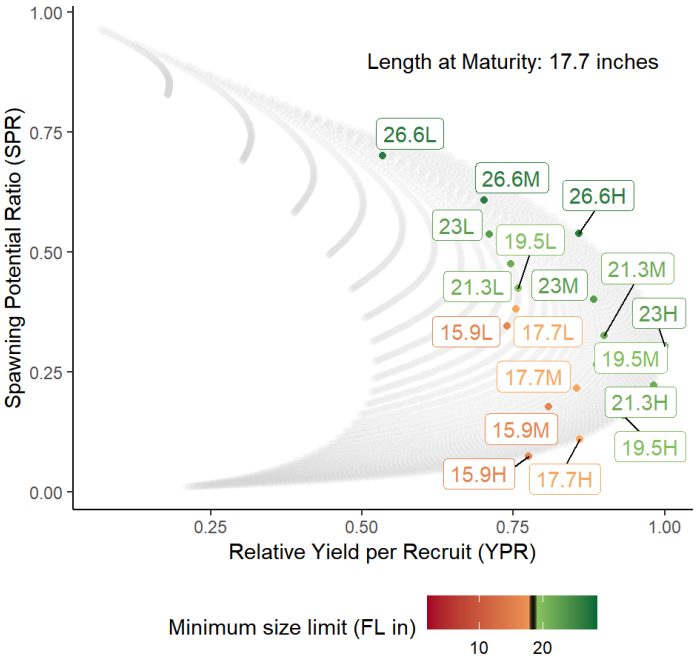
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Aprion virescens

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Lutjanus kasmira**

Hawaiian Name: Ta’ape

Common Name: Bluestipe Snapper

Family: Snappers

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 330 mm FL

K (von Bertalanffy growth parameter): 0.29 per year

t0 (von Bertalanffy parameter): -1.37

Lm (Length at maturity): 194 mm FL

Lm (Length at maturity): 8 inches FL

M (natural mortality rate): 0.4 per year

Longevity: 8 years

M/K: 1.38

Lm/Loo: 0.59

Lutjanus kasmira - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	175	6.9	**0.32**	**0.16**	**0.07**
1 x Lm	194	7.6	**0.38**	**0.23**	**0.13**
1.1 x Lm	213	8.4	**0.46**	**0.32**	**0.22**
1.2 x Lm	233	9.2	**0.55**	**0.42**	**0.34**
1.3 x Lm	252	9.9	**0.63**	**0.52**	**0.45**
1.5 x Lm	291	11.5	**0.82**	**0.76**	**0.72**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

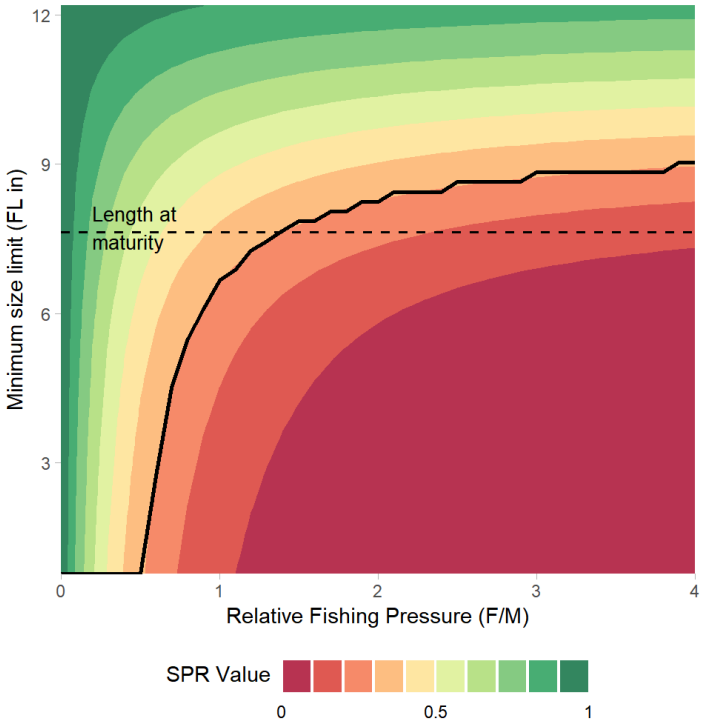
Lutjanus kasmira - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	175	6.9	**0.70**	**0.80**	**0.85**
1 x Lm	194	7.6	**0.70**	**0.84**	**0.93**
1.1 x Lm	213	8.4	**0.68**	**0.83**	**0.96**
1.2 x Lm	233	9.2	**0.63**	**0.80**	**0.96**
1.3 x Lm	252	9.9	**0.56**	**0.74**	**0.91**
1.5 x Lm	291	11.5	**0.35**	**0.50**	**0.70**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Lutjanus kasmira

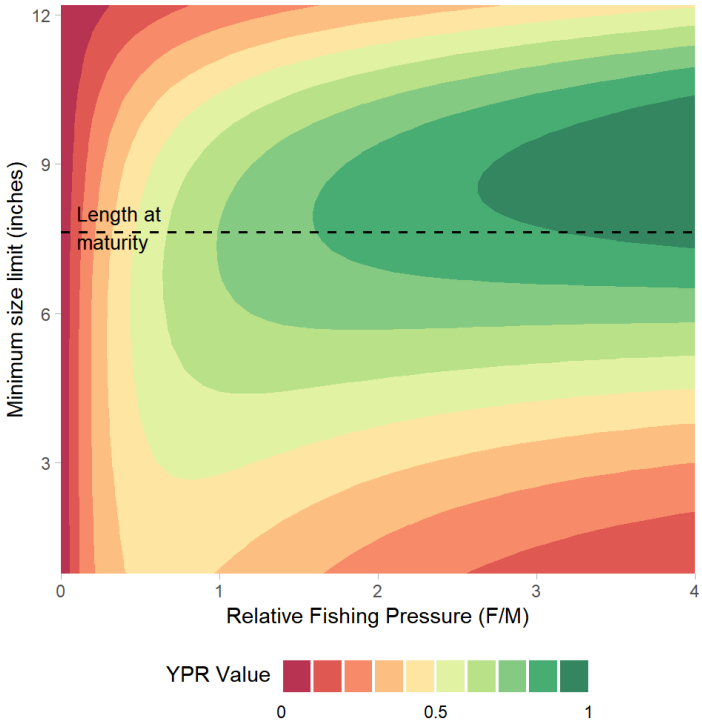
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Lutjanus kasmira

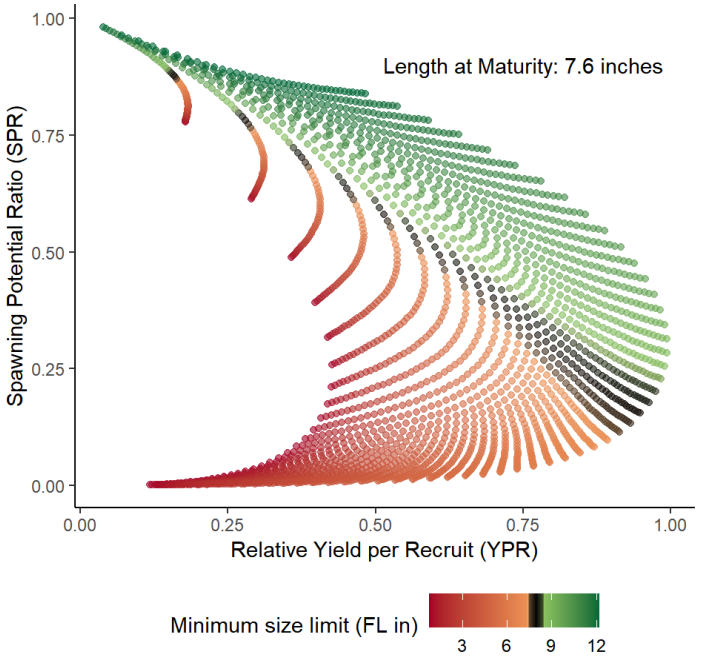
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Lutjanus kasmira

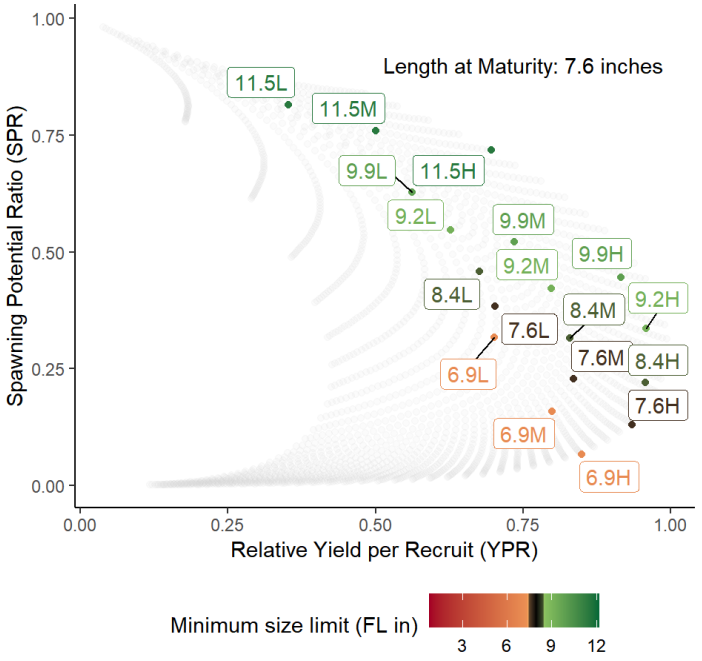
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Lutjanus kasmira

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Mugilidae - Mullets

Species: **Mugil cephalus**

Hawaiian Name: Ama’ama

Common Name: Striped Mullet

Family: Mullets

Current Minimum Size Limit (FL): 11 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 554 mm FL

K (von Bertalanffy growth parameter): 0.3 per year

t0 (von Bertalanffy parameter): -0.14

Lm (Length at maturity): 296 mm FL

Lm (Length at maturity): 12 inches FL

M (natural mortality rate): 0.25 per year

Longevity: 13 years

M/K: 0.83

Lm/Loo: 0.53

Mugil cephalus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	266	10.5	**0.33**	**0.16**	**0.07**
1 x Lm	296	11.7	**0.36**	**0.20**	**0.10**
1.1 x Lm	326	12.8	**0.40**	**0.24**	**0.14**
1.2 x Lm	355	14.0	**0.44**	**0.29**	**0.18**
1.3 x Lm	385	15.2	**0.49**	**0.34**	**0.25**
1.5 x Lm	444	17.5	**0.61**	**0.50**	**0.41**
Current size limit	279	11.0	**0.34**	**0.18**	**0.08**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

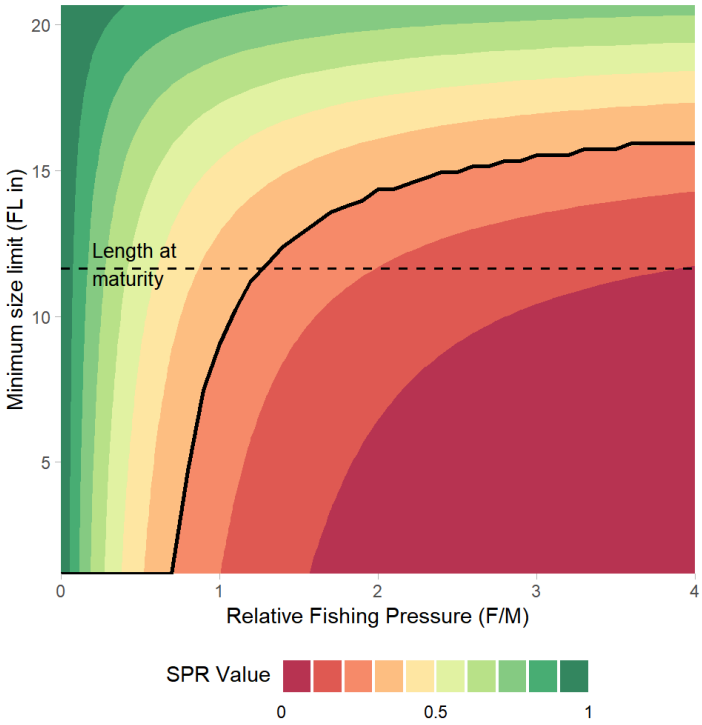
Mugil cephalus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	266	10.5	**0.71**	**0.75**	**0.69**
1 x Lm	296	11.7	**0.73**	**0.80**	**0.78**
1.1 x Lm	326	12.8	**0.74**	**0.84**	**0.86**
1.2 x Lm	355	14.0	**0.74**	**0.87**	**0.93**
1.3 x Lm	385	15.2	**0.73**	**0.89**	**0.98**
1.5 x Lm	444	17.5	**0.64**	**0.83**	**0.98**
Current size limit	279	11.0	**0.72**	**0.77**	**0.73**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Mugil cephalus

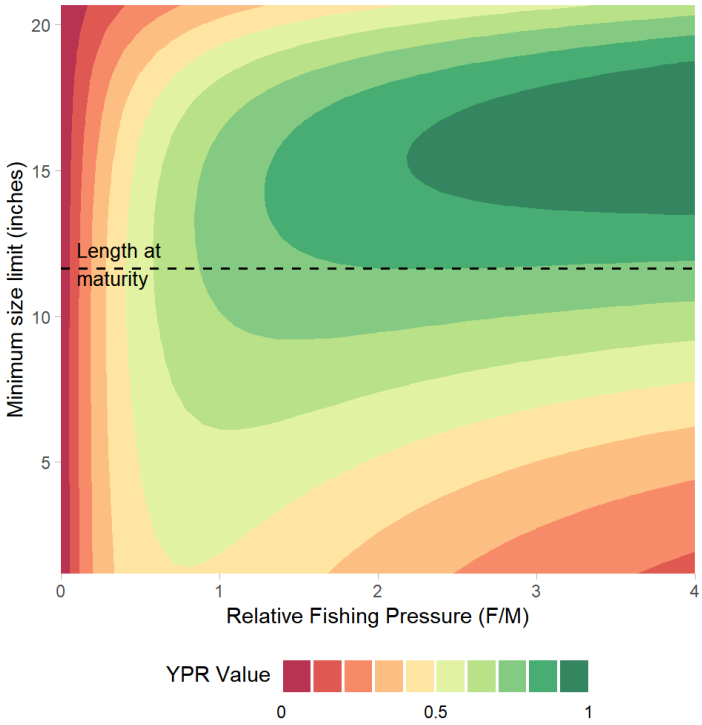
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Mugil cephalus

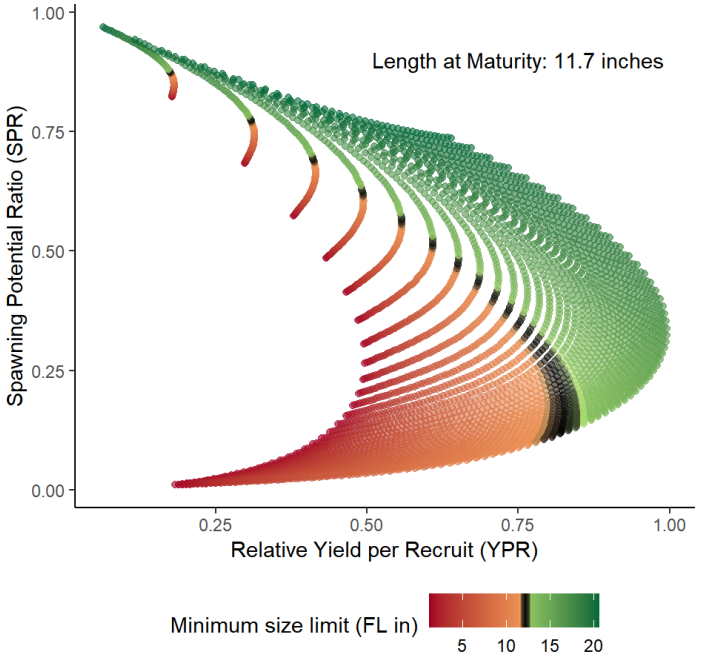
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Mugil cephalus

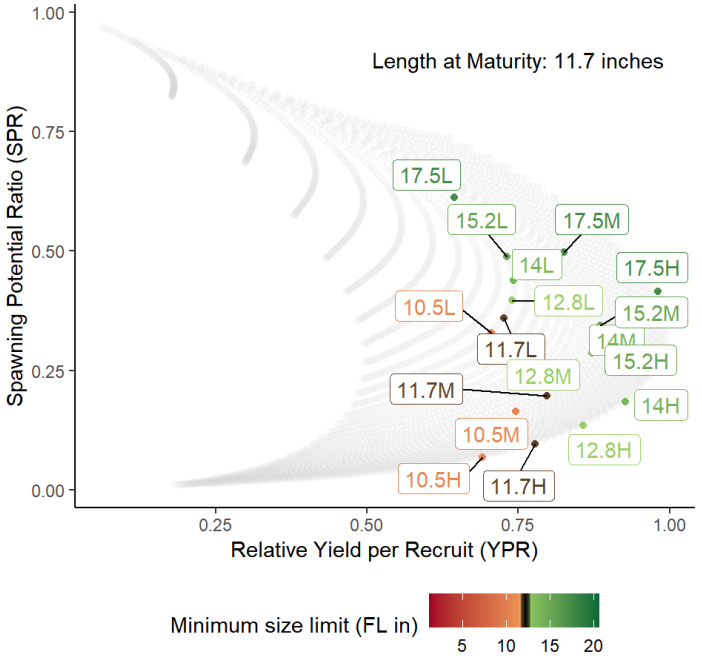
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Mugil cephalus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Mullidae - Goatfishes

Species: **Mulloidichthys flavolineatus**

Hawaiian Name: Weke’a

Common Name: Yellowstripe Goatfish

Family: Goatfishes

Current Minimum Size Limit (FL): 7 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 342 mm FL

K (von Bertalanffy growth parameter): 0.564 per year

t0 (von Bertalanffy parameter): -0.36

Lm (Length at maturity): 183 mm FL

Lm (Length at maturity): 7 inches FL

M (natural mortality rate): 0.54 per year

Longevity: 6 years

M/K: 0.96

Lm/Loo: 0.54

Mulloidichthys flavolineatus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	165	6.5	**0.32**	**0.16**	**0.07**
1 x Lm	183	7.2	**0.36**	**0.20**	**0.10**
1.1 x Lm	201	7.9	**0.40**	**0.24**	**0.14**
1.2 x Lm	220	8.7	**0.45**	**0.30**	**0.20**
1.3 x Lm	238	9.4	**0.51**	**0.37**	**0.27**
1.5 x Lm	274	10.8	**0.64**	**0.53**	**0.46**
Current size limit	178	7.0	**0.35**	**0.19**	**0.09**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

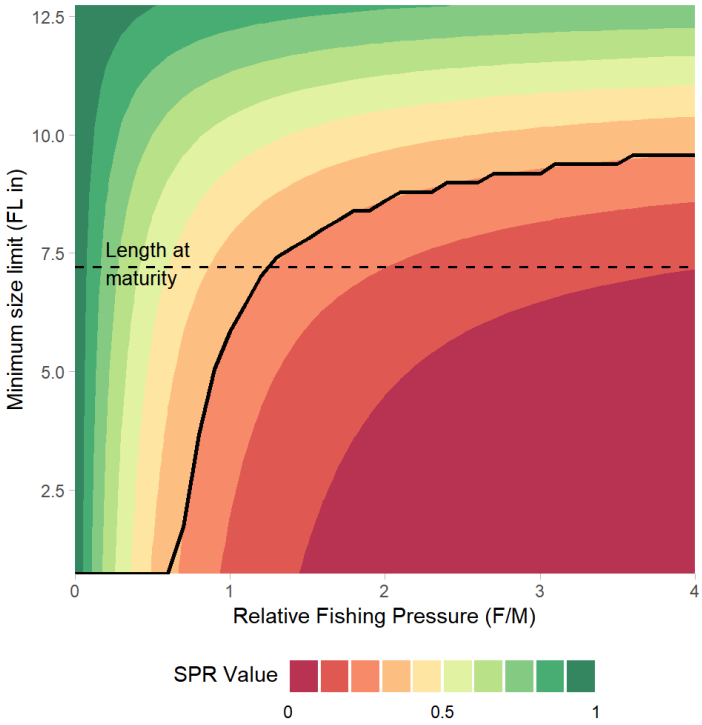
Mulloidichthys flavolineatus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	165	6.5	**0.68**	**0.72**	**0.69**
1 x Lm	183	7.2	**0.70**	**0.77**	**0.77**
1.1 x Lm	201	7.9	**0.71**	**0.82**	**0.86**
1.2 x Lm	220	8.7	**0.71**	**0.85**	**0.94**
1.3 x Lm	238	9.4	**0.69**	**0.85**	**0.97**
1.5 x Lm	274	10.8	**0.61**	**0.80**	**1.00**
Current size limit	178	7.0	**0.69**	**0.76**	**0.75**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Mulloidichthys flavolineatus

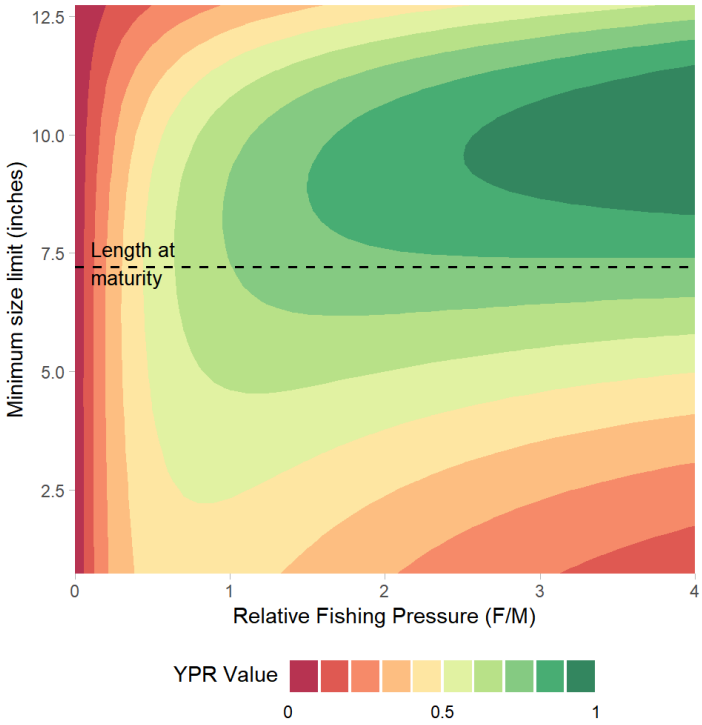
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Mulloidichthys flavolineatus

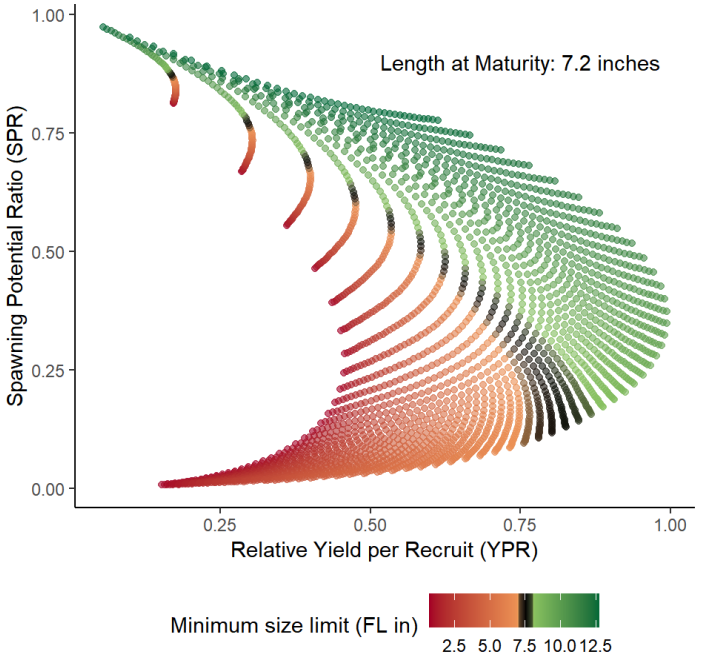
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Mulloidichthys flavolineatus

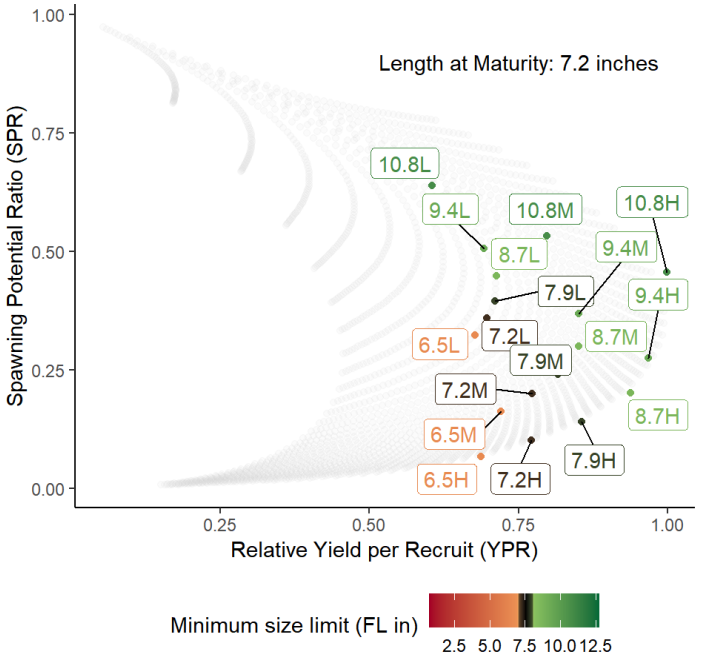
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Mulloidichthys flavolineatus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Mulloidichthys vanicolensis**

Hawaiian Name: Weke ’ula

Common Name: Yellowfin Goatfish

Family: Goatfishes

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 227 mm FL

K (von Bertalanffy growth parameter): 1.3 per year

t0 (von Bertalanffy parameter): -1.1

Lm (Length at maturity): 175 mm FL

Lm (Length at maturity): 7 inches FL

M (natural mortality rate): 0.64 per year

Longevity: 5 years

M/K: 0.49

Lm/Loo: 0.77

Mulloidichthys vanicolensis - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	158	6.2	**0.40**	**0.23**	**0.11**
1 x Lm	175	6.9	**0.46**	**0.30**	**0.18**
1.1 x Lm	193	7.6	**0.58**	**0.44**	**0.34**
1.2 x Lm	210	8.3	**0.70**	**0.61**	**0.54**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

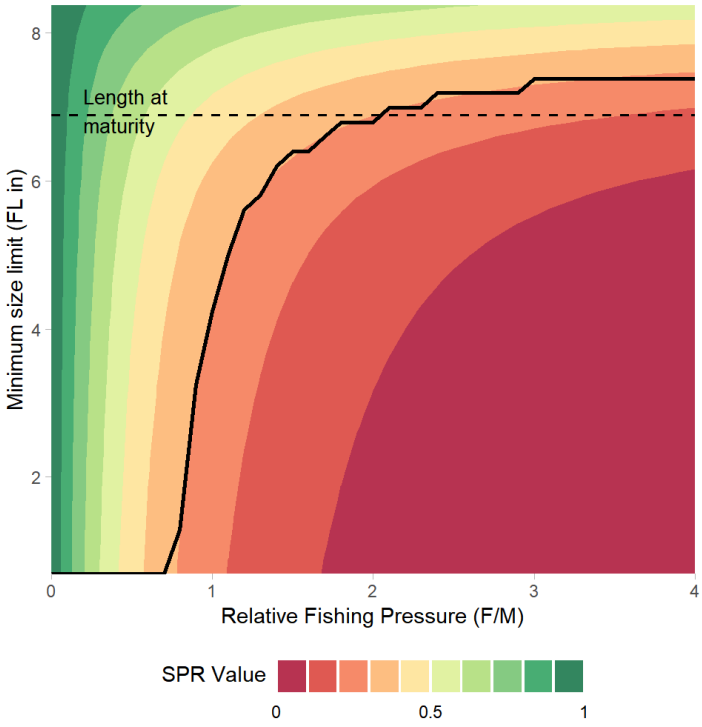
Mulloidichthys vanicolensis - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	158	6.2	**0.69**	**0.84**	**0.94**
1 x Lm	175	6.9	**0.68**	**0.87**	**1.00**
1.1 x Lm	193	7.6	**0.60**	**0.81**	**1.00**
1.2 x Lm	210	8.3	**0.50**	**0.73**	**1.00**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Mulloidichthys vanicolensis

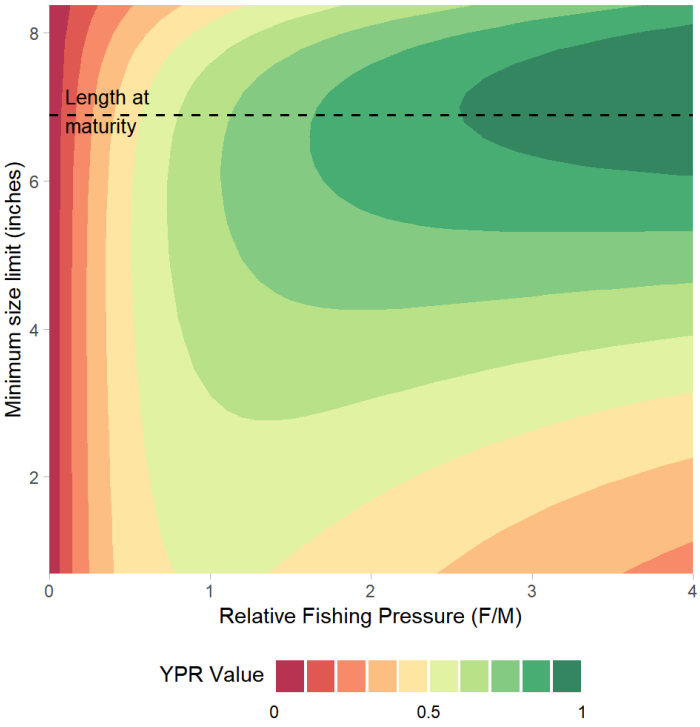
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Mulloidichthys vanicolensis

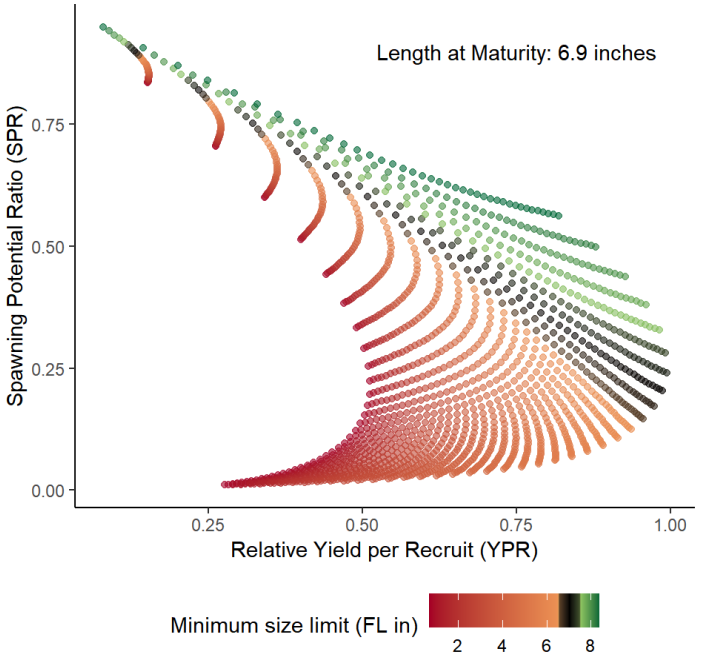
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Mulloidichthys vanicolensis

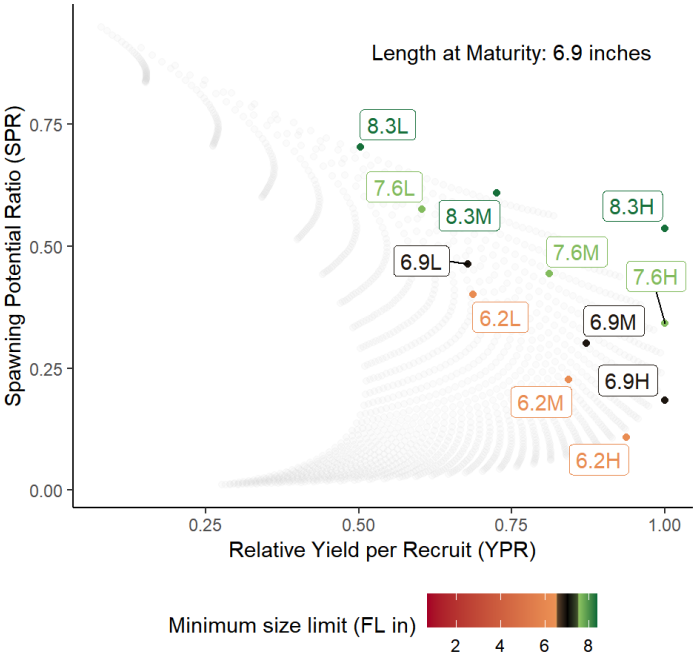
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Mulloidichthys vanicolensis

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Parupeneus multifasciatus**

Hawaiian Name: Moano

Common Name: Manybar Goatfish

Family: Goatfishes

Current Minimum Size Limit (FL): 7 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 303 mm FL

K (von Bertalanffy growth parameter): 0.7556 per year

t0 (von Bertalanffy parameter): -0.135

Lm (Length at maturity): 145 mm FL

Lm (Length at maturity): 6 inches FL

M (natural mortality rate): 0.64 per year

Longevity: 5 years

M/K: 0.85

Lm/Loo: 0.48

Parupeneus multifasciatus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	130	5.1	**0.31**	**0.15**	**0.06**
1 x Lm	145	5.7	**0.34**	**0.18**	**0.08**
1.1 x Lm	160	6.3	**0.37**	**0.21**	**0.11**
1.2 x Lm	174	6.9	**0.40**	**0.25**	**0.15**
1.3 x Lm	188	7.4	**0.44**	**0.29**	**0.19**
1.5 x Lm	218	8.6	**0.53**	**0.40**	**0.31**
Current size limit	178	7.0	**0.41**	**0.26**	**0.16**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

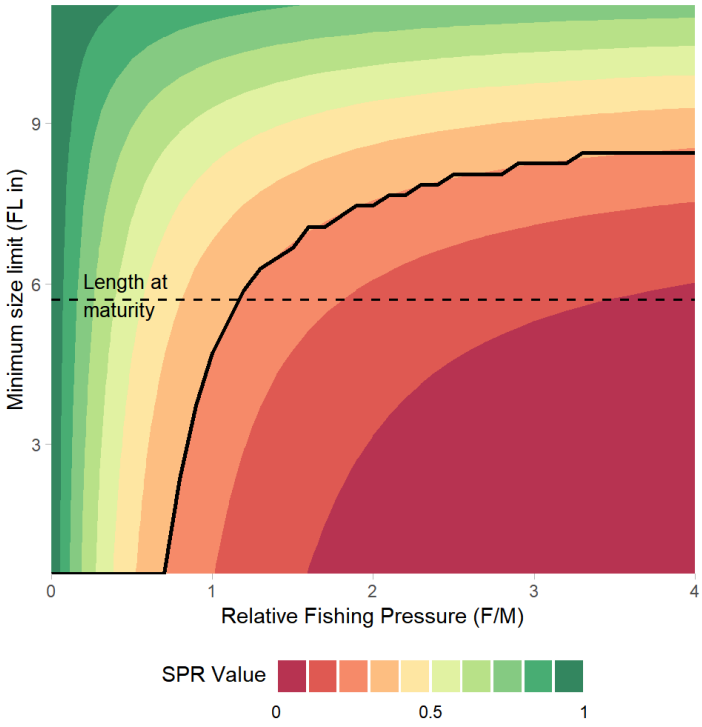
Parupeneus multifasciatus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	130	5.1	**0.62**	**0.63**	**0.56**
1 x Lm	145	5.7	**0.64**	**0.68**	**0.64**
1.1 x Lm	160	6.3	**0.66**	**0.73**	**0.72**
1.2 x Lm	174	6.9	**0.68**	**0.77**	**0.80**
1.3 x Lm	188	7.4	**0.68**	**0.80**	**0.85**
1.5 x Lm	218	8.6	**0.66**	**0.82**	**0.95**
Current size limit	178	7.0	**0.68**	**0.78**	**0.81**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Parupeneus multifasciatus

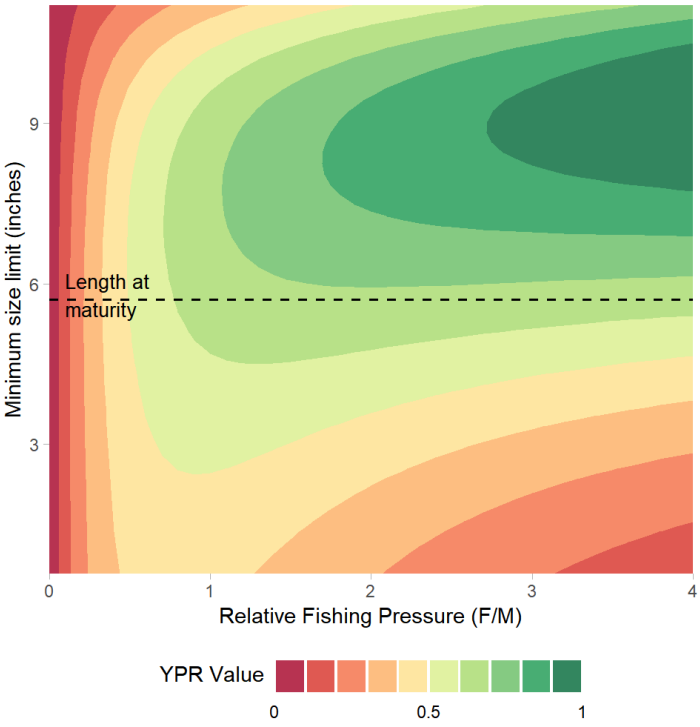
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Parupeneus multifasciatus

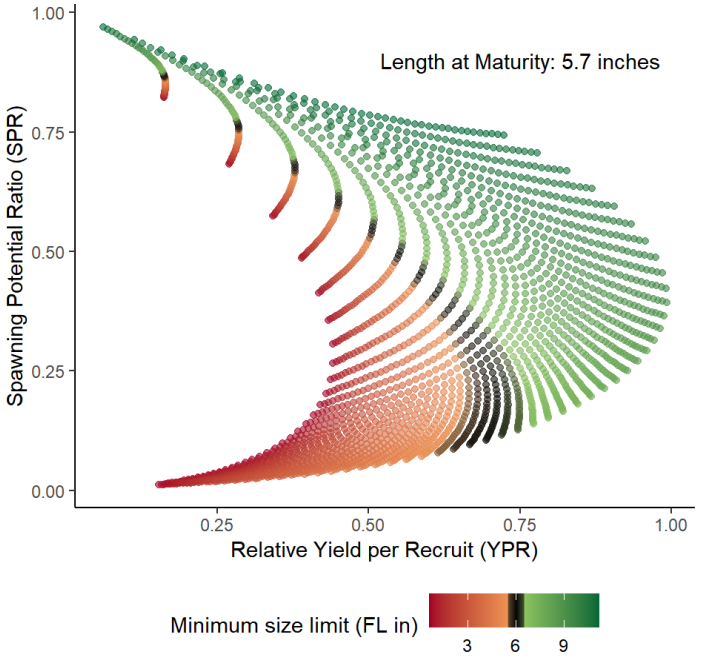
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Parupeneus multifasciatus

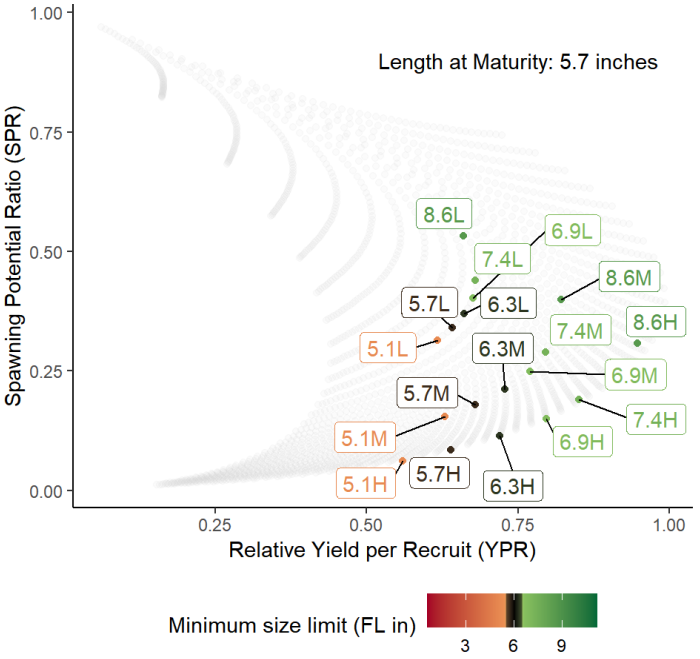
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Parupeneus multifasciatus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Parupeneus porphyreus**

Hawaiian Name: Kumu

Common Name: Whitesaddle Goatfish

Family: Goatfishes

Current Minimum Size Limit (FL): 10 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 492 mm FL

K (von Bertalanffy growth parameter): 0.538 per year

t0 (von Bertalanffy parameter): -0.446

Lm (Length at maturity): 238 mm FL

Lm (Length at maturity): 9 inches FL

M (natural mortality rate): 0.54 per year

Longevity: 6 years

M/K: 1

Lm/Loo: 0.48

Parupeneus porphyreus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	214	8.4	**0.31**	**0.15**	**0.06**
1 x Lm	238	9.4	**0.34**	**0.18**	**0.09**
1.1 x Lm	262	10.3	**0.37**	**0.21**	**0.12**
1.2 x Lm	286	11.3	**0.40**	**0.25**	**0.16**
1.3 x Lm	309	12.2	**0.45**	**0.30**	**0.21**
1.5 x Lm	357	14.1	**0.55**	**0.42**	**0.33**
Current size limit	254	10.0	**0.36**	**0.20**	**0.11**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

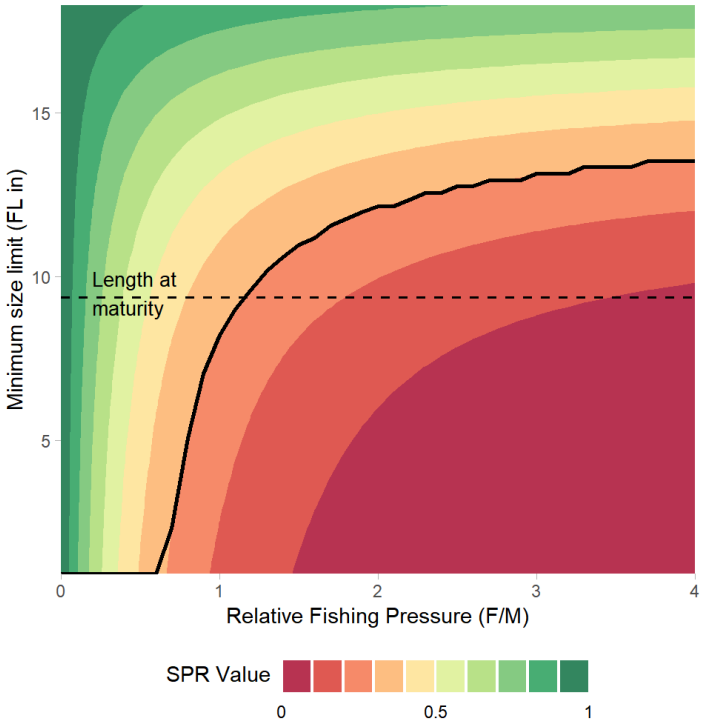
Parupeneus porphyreus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	214	8.4	**0.68**	**0.70**	**0.63**
1 x Lm	238	9.4	**0.71**	**0.75**	**0.71**
1.1 x Lm	262	10.3	**0.72**	**0.79**	**0.78**
1.2 x Lm	286	11.3	**0.74**	**0.84**	**0.87**
1.3 x Lm	309	12.2	**0.74**	**0.87**	**0.93**
1.5 x Lm	357	14.1	**0.70**	**0.86**	**0.98**
Current size limit	254	10.0	**0.72**	**0.79**	**0.77**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Parupeneus porphyreus

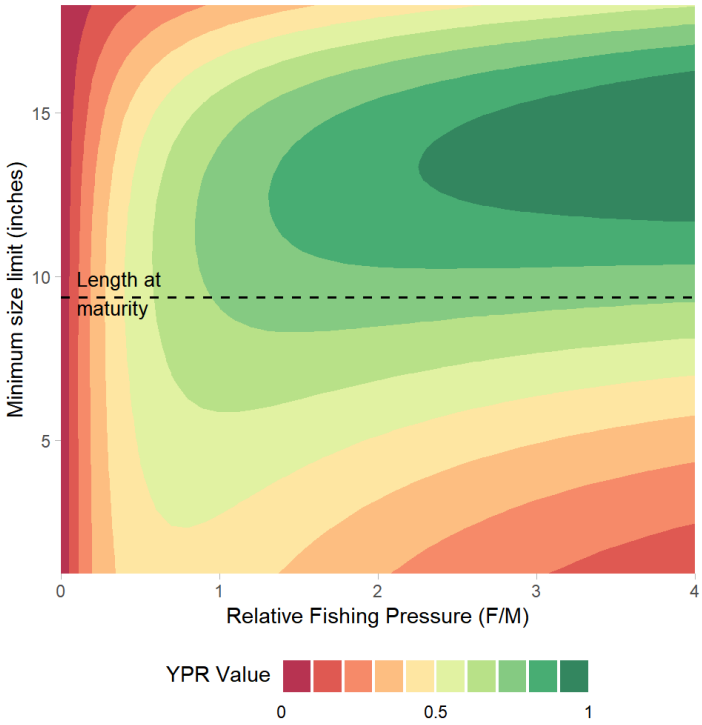
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Parupeneus porphyreus

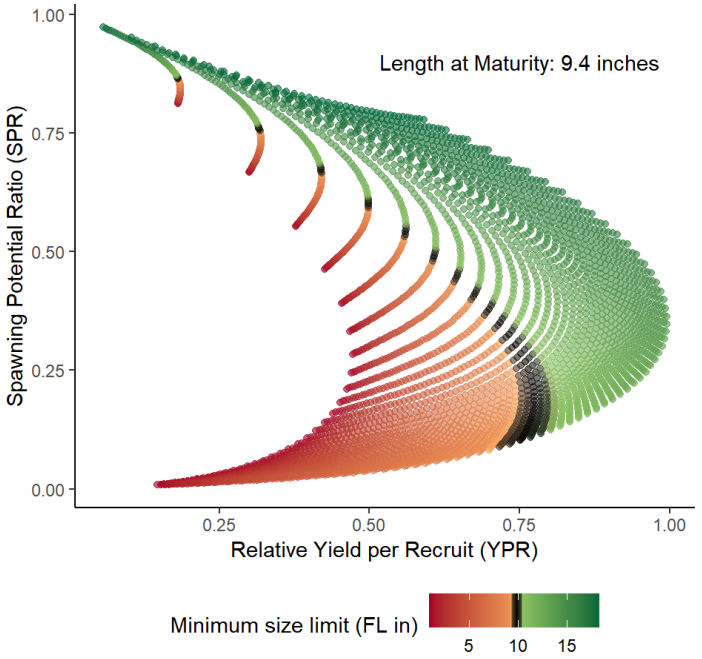
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Parupeneus porphyreus

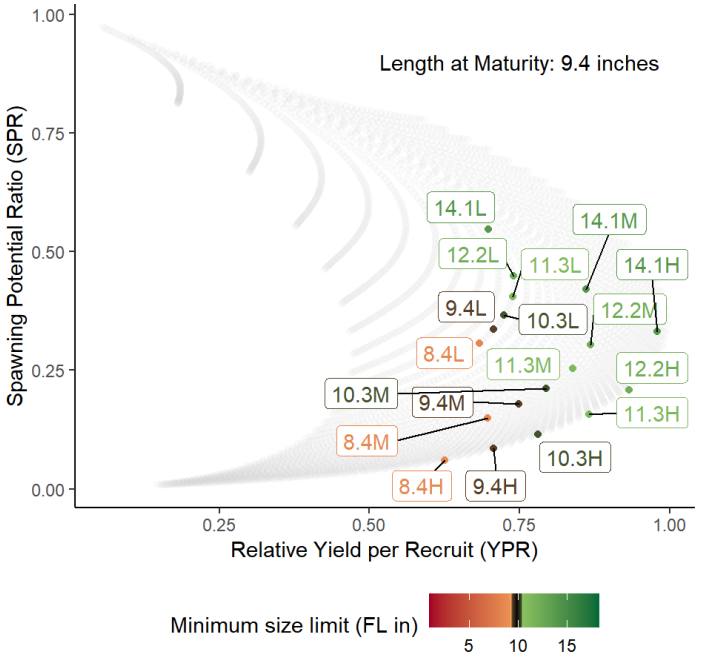
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Parupeneus porphyreus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Scaridae - Parrotfishes

Species: **Chlorurus perspicillatus**

Hawaiian Name: Uhu-uliuli

Common Name: Spectacled Parrotfish

Family: Parrotfishes

Current Minimum Size Limit (FL): 12 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 532 mm FL

K (von Bertalanffy growth parameter): 0.225 per year

t0 (von Bertalanffy parameter): -1.48

Lm (Length at maturity): 350 mm FL

Lm (Length at maturity): 14 inches FL

M (natural mortality rate): 0.16 per year

Longevity: 20 years

M/K: 0.71

Lm/Loo: 0.66

Chlorurus perspicillatus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	315	12.4	**0.36**	**0.19**	**0.08**
1 x Lm	350	13.8	**0.40**	**0.24**	**0.13**
1.1 x Lm	385	15.2	**0.46**	**0.31**	**0.20**
1.2 x Lm	420	16.5	**0.54**	**0.40**	**0.31**
1.3 x Lm	455	17.9	**0.64**	**0.53**	**0.44**
Current size limit	305	12.0	**0.34**	**0.17**	**0.07**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

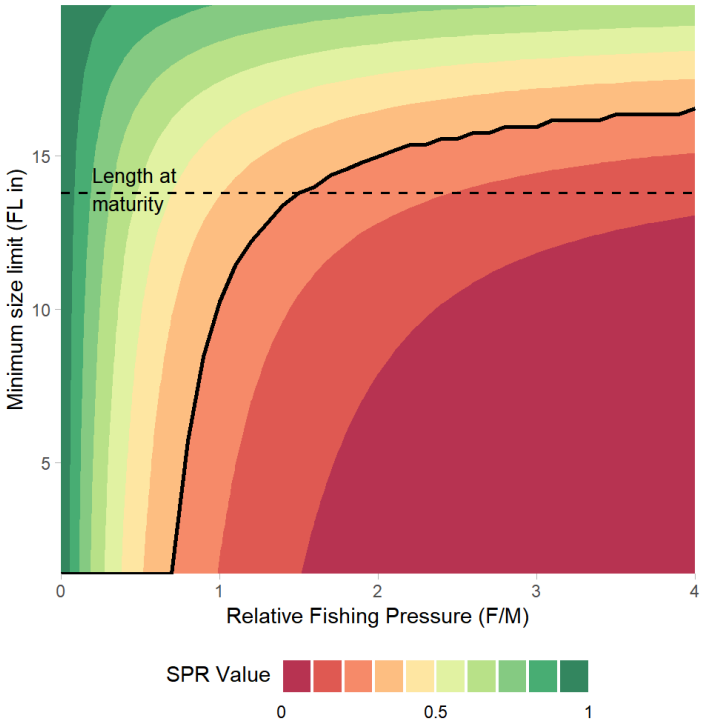
Chlorurus perspicillatus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	315	12.4	**0.73**	**0.83**	**0.84**
1 x Lm	350	13.8	**0.73**	**0.87**	**0.92**
1.1 x Lm	385	15.2	**0.72**	**0.88**	**0.98**
1.2 x Lm	420	16.5	**0.68**	**0.86**	**1.00**
1.3 x Lm	455	17.9	**0.59**	**0.77**	**0.94**
Current size limit	305	12.0	**0.72**	**0.81**	**0.81**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Chlorurus perspicillatus

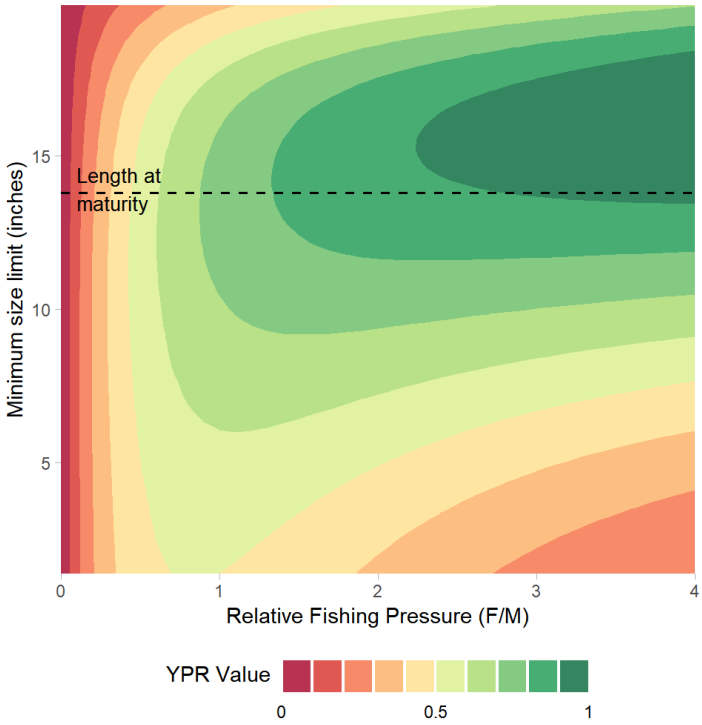
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Chlorurus perspicillatus

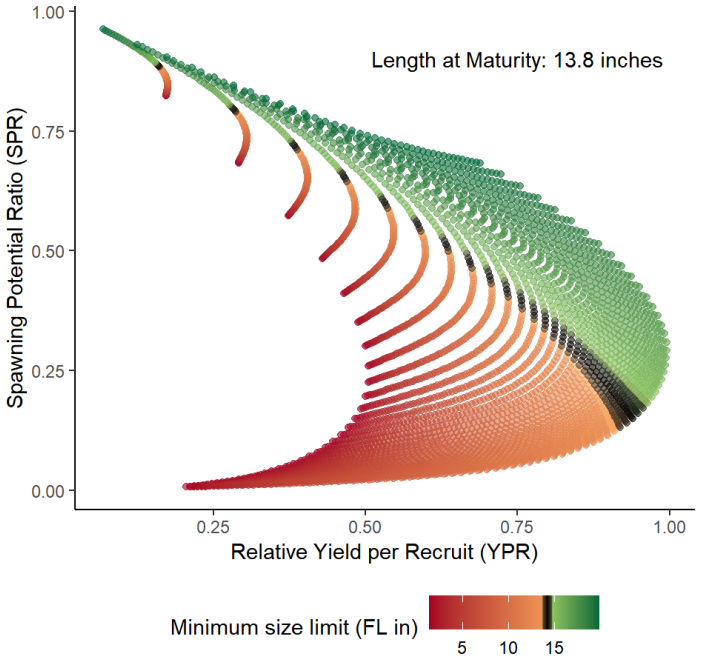
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Chlorurus perspicillatus

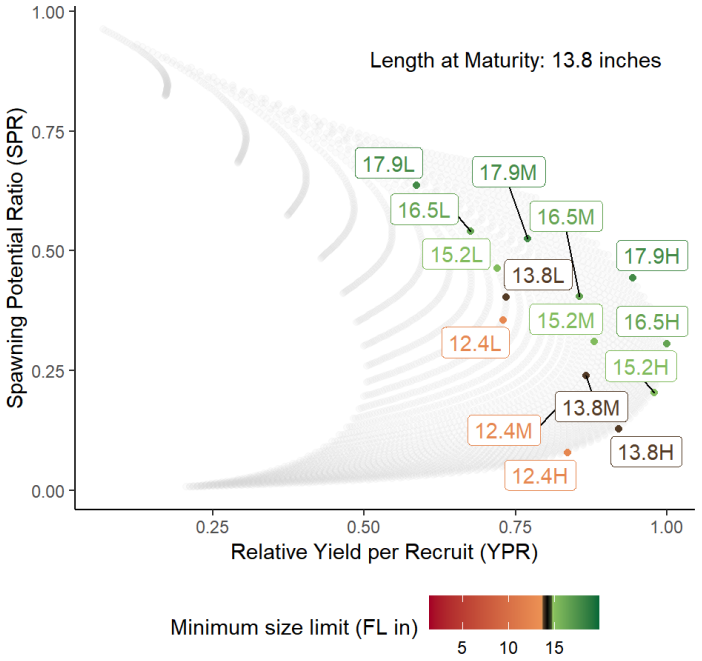
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Chlorurus perspicillatus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Chlorurus sordidus**

Hawaiian Name: Uhu

Common Name: Bullethead Parrotfish

Family: Parrotfishes

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 294 mm FL

K (von Bertalanffy growth parameter): 0.442 per year

t0 (von Bertalanffy parameter): -0.756

Lm (Length at maturity): 170 mm FL

Lm (Length at maturity): 7 inches FL

M (natural mortality rate): 0.32 per year

Longevity: 10 years

M/K: 0.72

Lm/Loo: 0.58

Chlorurus sordidus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	153	6.0	**0.35**	**0.19**	**0.08**
1 x Lm	170	6.7	**0.39**	**0.22**	**0.12**
1.1 x Lm	187	7.4	**0.43**	**0.27**	**0.16**
1.2 x Lm	204	8.0	**0.48**	**0.33**	**0.23**
1.3 x Lm	221	8.7	**0.53**	**0.40**	**0.30**
1.5 x Lm	255	10.0	**0.69**	**0.60**	**0.53**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

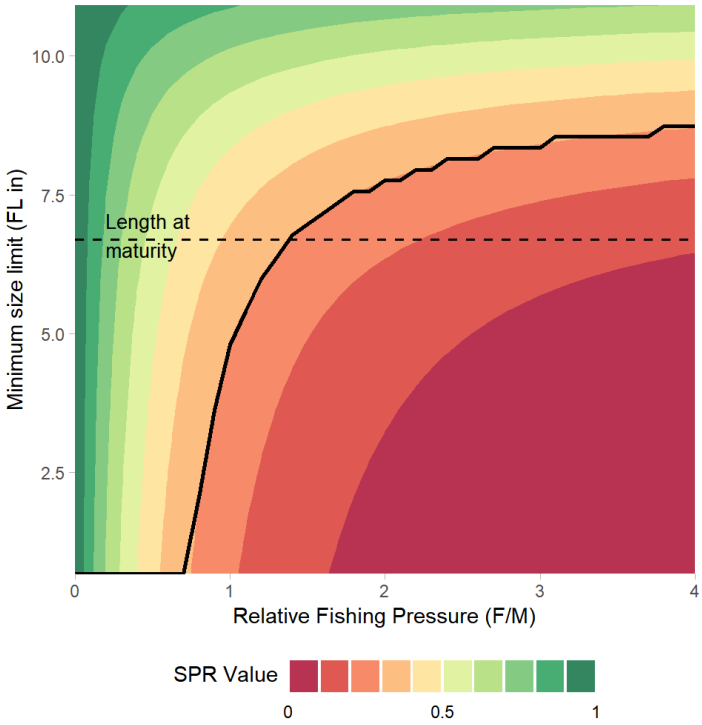
Chlorurus sordidus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	153	6.0	**0.68**	**0.76**	**0.75**
1 x Lm	170	6.7	**0.70**	**0.81**	**0.84**
1.1 x Lm	187	7.4	**0.70**	**0.83**	**0.89**
1.2 x Lm	204	8.0	**0.70**	**0.86**	**0.98**
1.3 x Lm	221	8.7	**0.68**	**0.86**	**1.00**
1.5 x Lm	255	10.0	**0.54**	**0.75**	**0.99**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Chlorurus sordidus

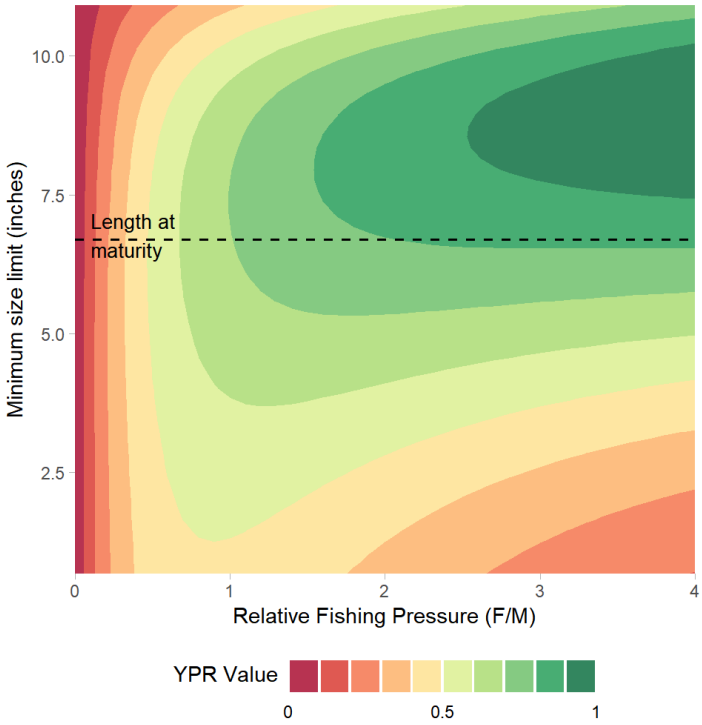
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Chlorurus sordidus

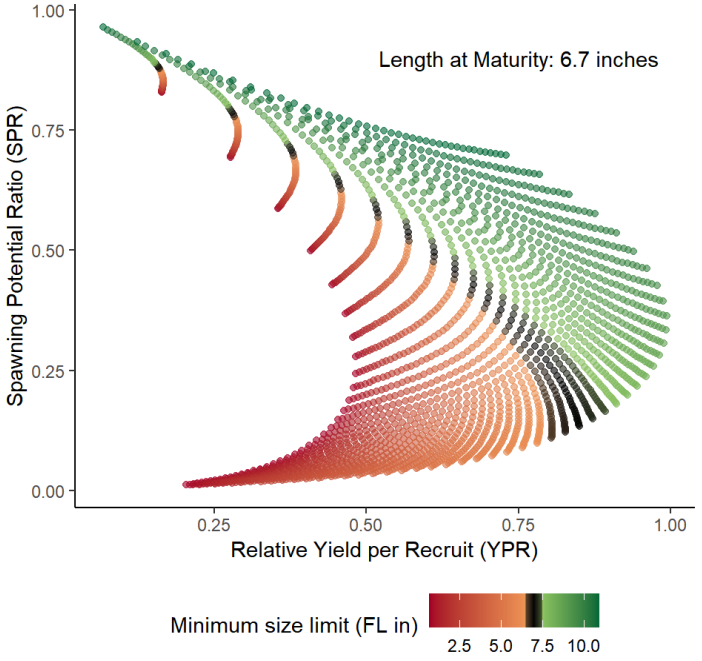
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Chlorurus sordidus

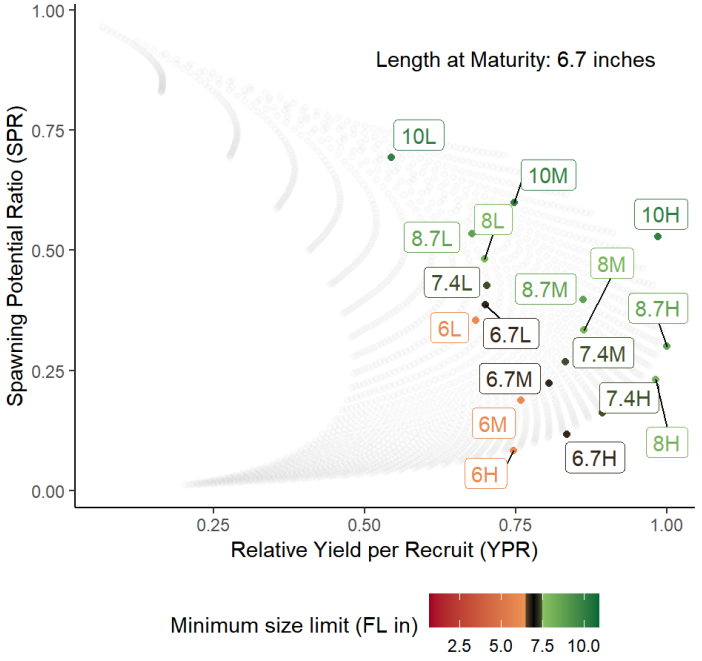
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Chlorurus sordidus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Chlorurus spilurus**

Hawaiian Name: Uhu

Common Name: Pacific Daisy Parrotfish

Family: Parrotfishes

Current Minimum Size Limit (FL): 12 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 344 mm FL

K (von Bertalanffy growth parameter): 0.4 per year

t0 (von Bertalanffy parameter): -0.13

Lm (Length at maturity): 172 mm FL

Lm (Length at maturity): 7 inches FL

M (natural mortality rate): 0.29 per year

Longevity: 11 years

M/K: 0.72

Lm/Loo: 0.5

Chlorurus spilurus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	155	6.1	**0.34**	**0.17**	**0.07**
1 x Lm	172	6.8	**0.36**	**0.19**	**0.09**
1.1 x Lm	189	7.4	**0.39**	**0.23**	**0.13**
1.2 x Lm	206	8.1	**0.42**	**0.26**	**0.16**
1.3 x Lm	224	8.8	**0.46**	**0.31**	**0.21**
1.5 x Lm	258	10.2	**0.55**	**0.42**	**0.33**
Current size limit	305	12.0	**0.73**	**0.65**	**0.59**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

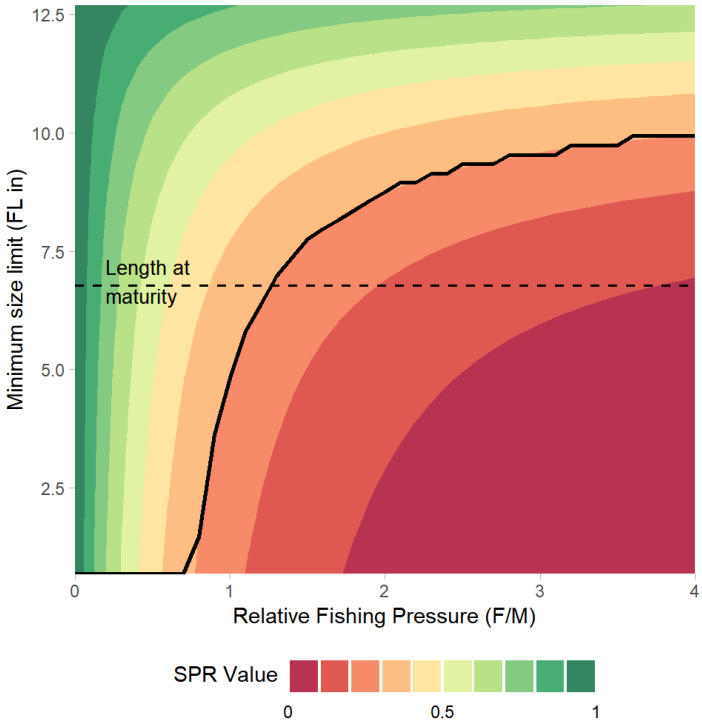
Chlorurus spilurus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	155	6.1	**0.68**	**0.72**	**0.66**
1 x Lm	172	6.8	**0.70**	**0.76**	**0.72**
1.1 x Lm	189	7.4	**0.72**	**0.81**	**0.81**
1.2 x Lm	206	8.1	**0.73**	**0.84**	**0.88**
1.3 x Lm	224	8.8	**0.73**	**0.87**	**0.95**
1.5 x Lm	258	10.2	**0.69**	**0.87**	**1.00**
Current size limit	305	12.0	**0.52**	**0.71**	**0.94**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Chlorurus spilurus

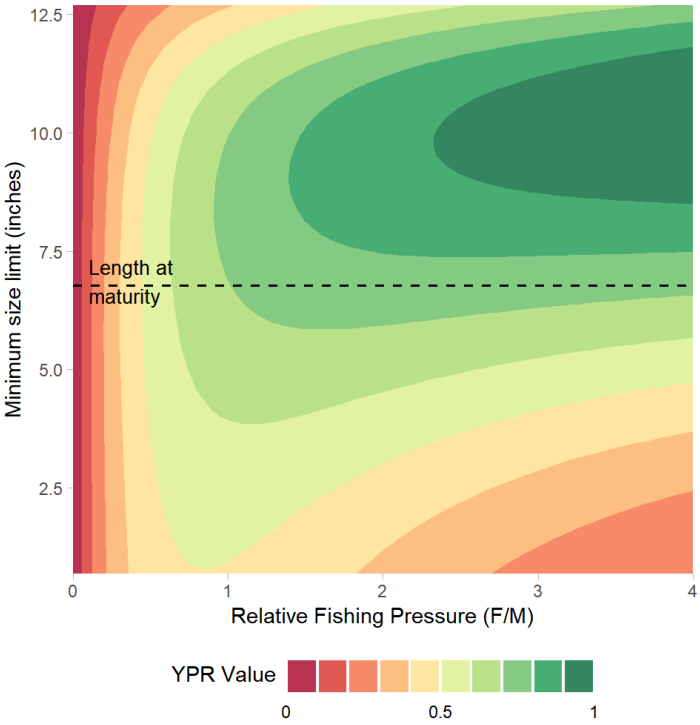
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Chlorurus spilurus

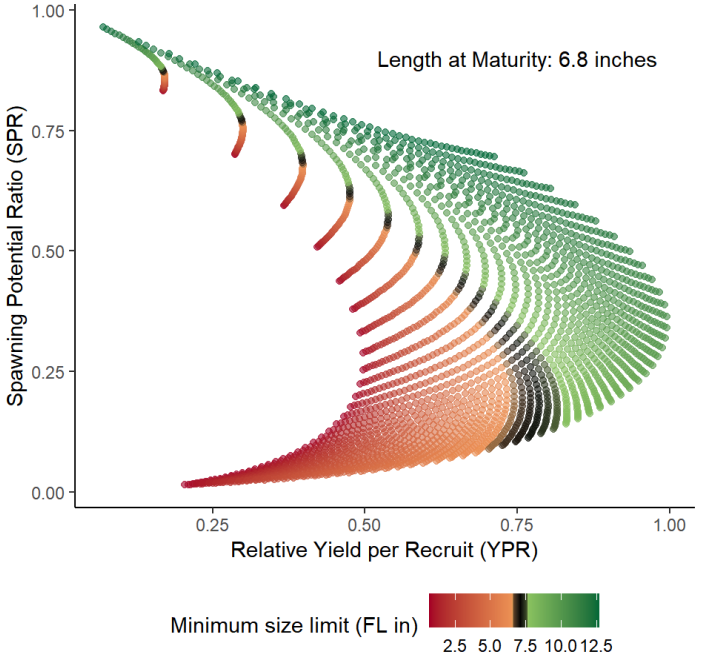
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Chlorurus spilurus

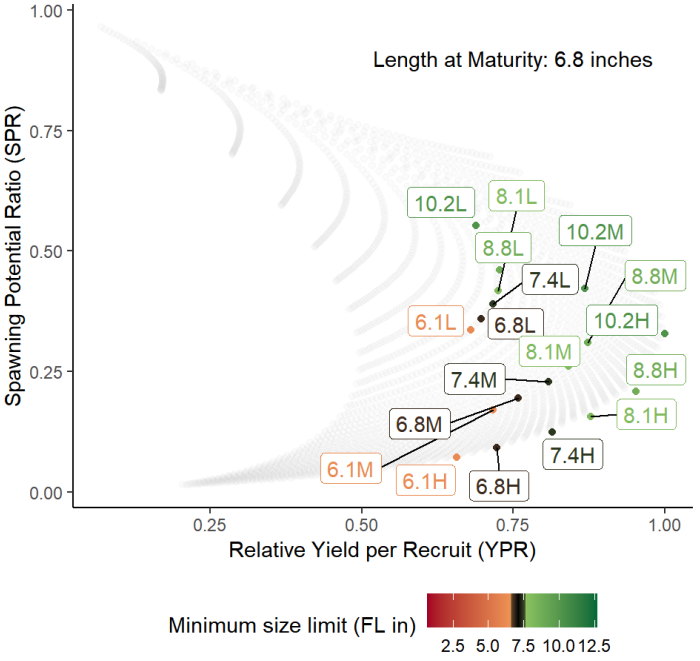
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Chlorurus spilurus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Scarus psittacus**

Hawaiian Name: Uhu

Common Name: Palenose Parrotfish

Family: Parrotfishes

Current Minimum Size Limit (FL): 12 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 327 mm FL

K (von Bertalanffy growth parameter): 0.486 per year

t0 (von Bertalanffy parameter): -0.01

Lm (Length at maturity): 139 mm FL

Lm (Length at maturity): 5 inches FL

M (natural mortality rate): 0.54 per year

Longevity: 6 years

M/K: 1.11

Lm/Loo: 0.43

Scarus psittacus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	125	4.9	**0.29**	**0.13**	**0.05**
1 x Lm	139	5.5	**0.31**	**0.16**	**0.07**
1.1 x Lm	153	6.0	**0.34**	**0.19**	**0.10**
1.2 x Lm	167	6.6	**0.36**	**0.21**	**0.12**
1.3 x Lm	181	7.1	**0.40**	**0.25**	**0.16**
1.5 x Lm	208	8.2	**0.48**	**0.34**	**0.25**
2 x Lm	278	10.9	**0.75**	**0.68**	**0.62**
Current size limit	305	12.0	**0.86**	**0.82**	**0.79**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

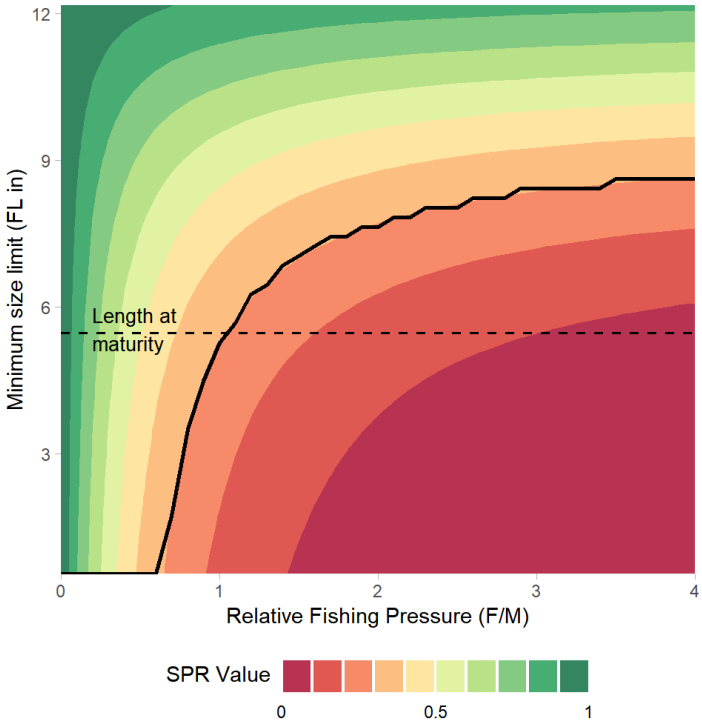
Scarus psittacus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	125	4.9	**0.61**	**0.59**	**0.51**
1 x Lm	139	5.5	**0.64**	**0.65**	**0.59**
1.1 x Lm	153	6.0	**0.66**	**0.69**	**0.66**
1.2 x Lm	167	6.6	**0.67**	**0.73**	**0.72**
1.3 x Lm	181	7.1	**0.69**	**0.78**	**0.81**
1.5 x Lm	208	8.2	**0.69**	**0.83**	**0.91**
2 x Lm	278	10.9	**0.47**	**0.64**	**0.83**
Current size limit	305	12.0	**0.32**	**0.46**	**0.65**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Scarus psittacus

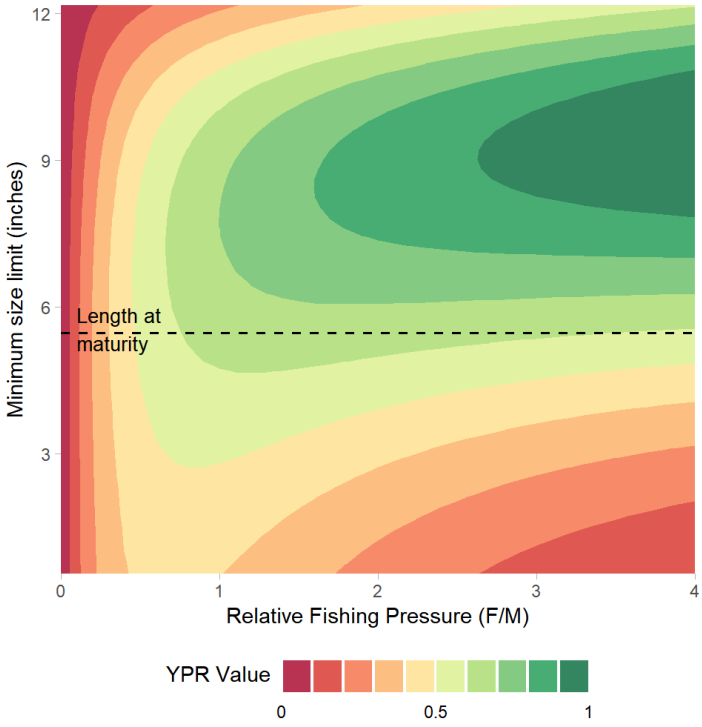
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Scarus psittacus

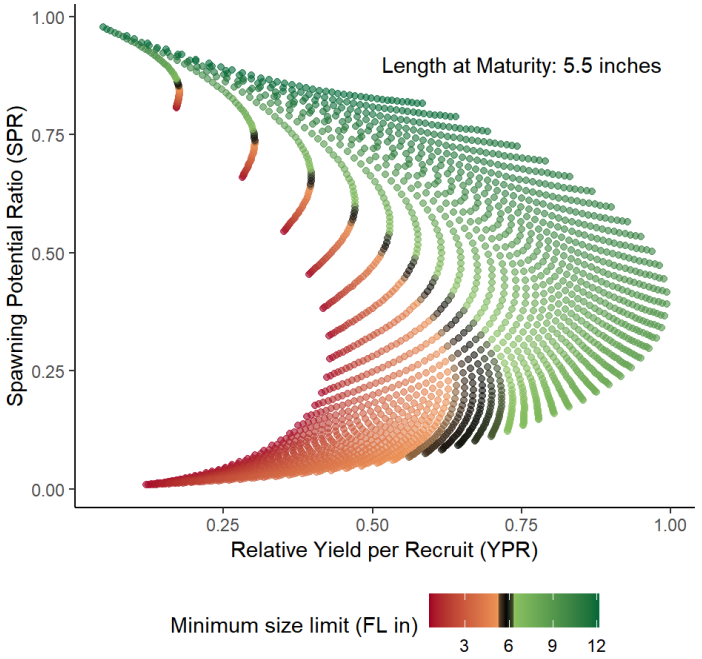
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Scarus psittacus

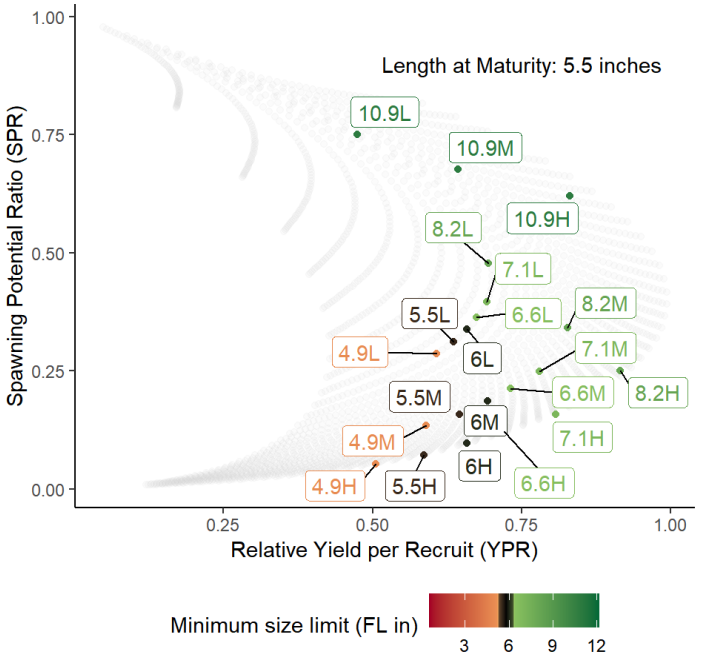
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Scarus psittacus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Species: **Scarus rubroviolaceus**

Hawaiian Name: Uhu palukaluka

Common Name: Redlip Parrotfish

Family: Parrotfishes

Current Minimum Size Limit (FL): 12 inches

Life History Parameters

Loo (von Bertalanffy asymtotic size): 535 mm FL

K (von Bertalanffy growth parameter): 0.41 per year

t0 (von Bertalanffy parameter): 0.12

Lm (Length at maturity): 350 mm FL

Lm (Length at maturity): 14 inches FL

M (natural mortality rate): 0.16 per year

Longevity: 20 years

M/K: 0.39

Lm/Loo: 0.65

Scarus rubroviolaceus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	315	12.4	**0.39**	**0.21**	**0.10**
1 x Lm	350	13.8	**0.42**	**0.25**	**0.13**
1.1 x Lm	385	15.2	**0.45**	**0.29**	**0.17**
1.2 x Lm	420	16.5	**0.50**	**0.35**	**0.23**
1.3 x Lm	455	17.9	**0.57**	**0.43**	**0.33**
Current size limit	305	12.0	**0.38**	**0.21**	**0.09**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

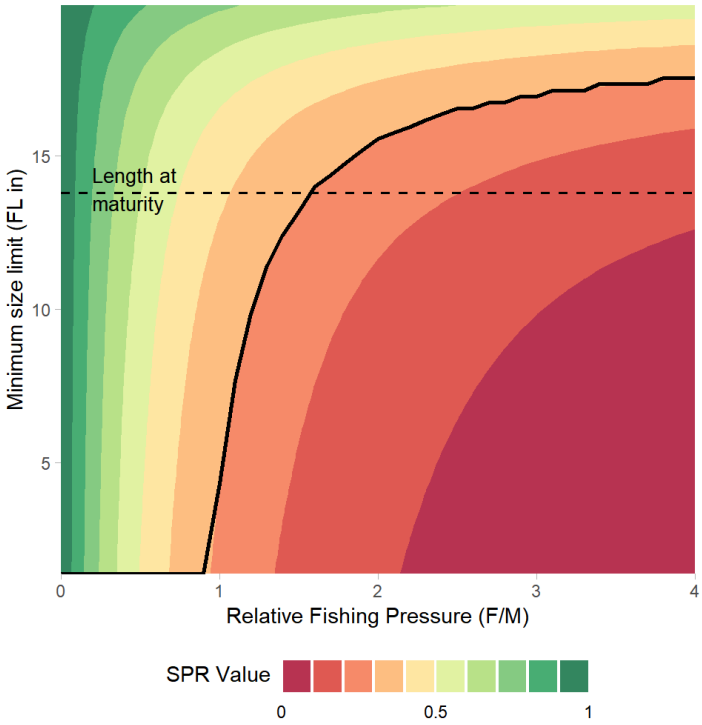
Scarus rubroviolaceus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	315	12.4	**0.70**	**0.80**	**0.78**
1 x Lm	350	13.8	**0.71**	**0.83**	**0.86**
1.1 x Lm	385	15.2	**0.71**	**0.86**	**0.93**
1.2 x Lm	420	16.5	**0.70**	**0.88**	**0.98**
1.3 x Lm	455	17.9	**0.65**	**0.84**	**1.00**
Current size limit	305	12.0	**0.69**	**0.78**	**0.76**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Scarus rubroviolaceus

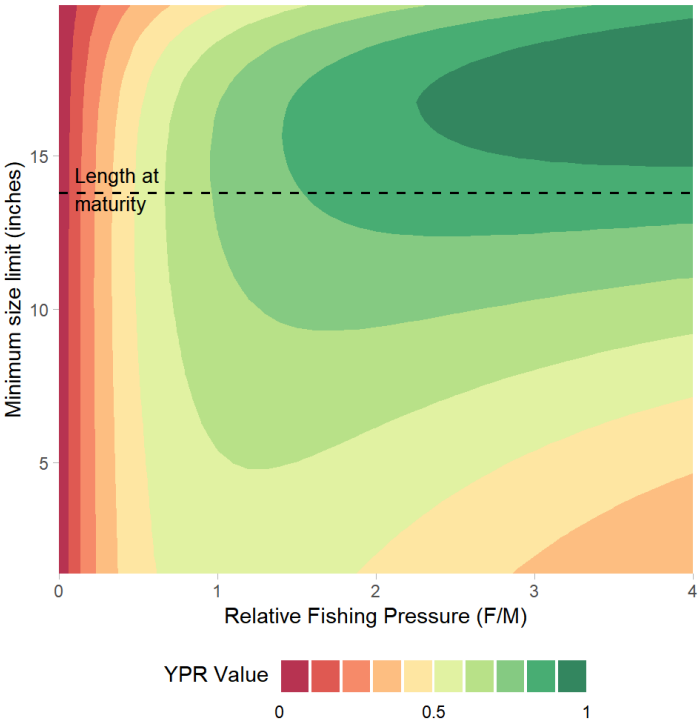
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Scarus rubroviolaceus

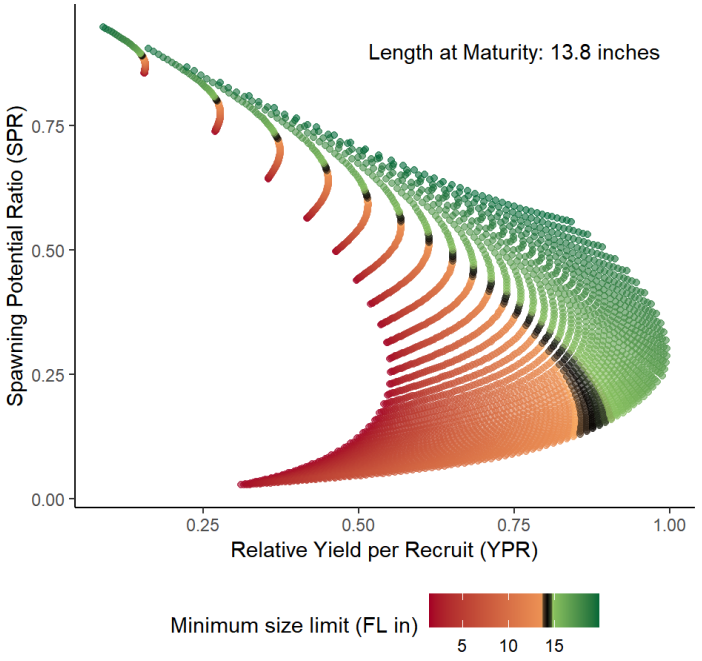
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Scarus rubroviolaceus

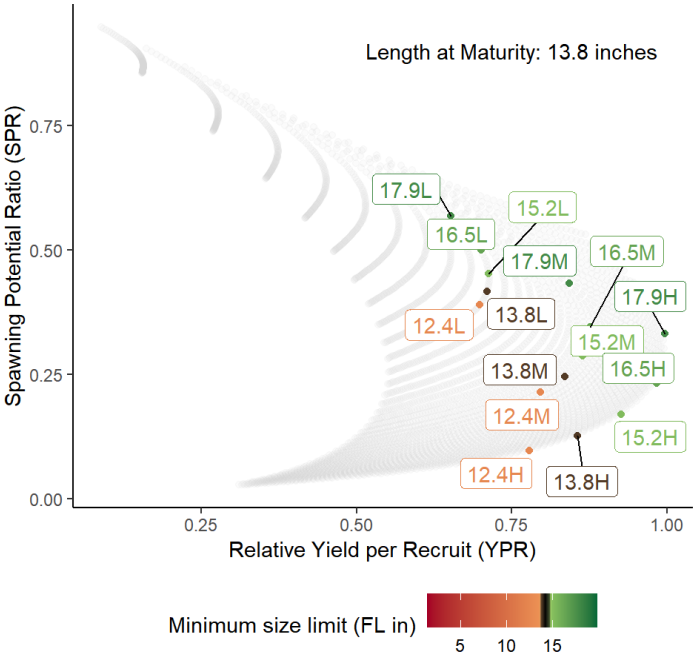
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Scarus rubroviolaceus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Serranidae - Sea basses

Species: **Cephalopholis argus**

Hawaiian Name: Roi

Common Name: Peacock Grouper

Family: Sea basses

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 506 mm FL

K (von Bertalanffy growth parameter): 0.075 per year

t0 (von Bertalanffy parameter): -6.5

Lm (Length at maturity): 268 mm FL

Lm (Length at maturity): 11 inches FL

M (natural mortality rate): 0.13 per year

Longevity: 25 years

M/K: 1.73

Lm/Loo: 0.53

Cephalopholis argus - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	241	9.5	**0.30**	**0.15**	**0.06**
1 x Lm	268	10.6	**0.37**	**0.22**	**0.12**
1.1 x Lm	295	11.6	**0.44**	**0.29**	**0.20**
1.2 x Lm	322	12.7	**0.51**	**0.38**	**0.29**
1.3 x Lm	348	13.7	**0.60**	**0.49**	**0.41**
1.5 x Lm	402	15.8	**0.75**	**0.68**	**0.63**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

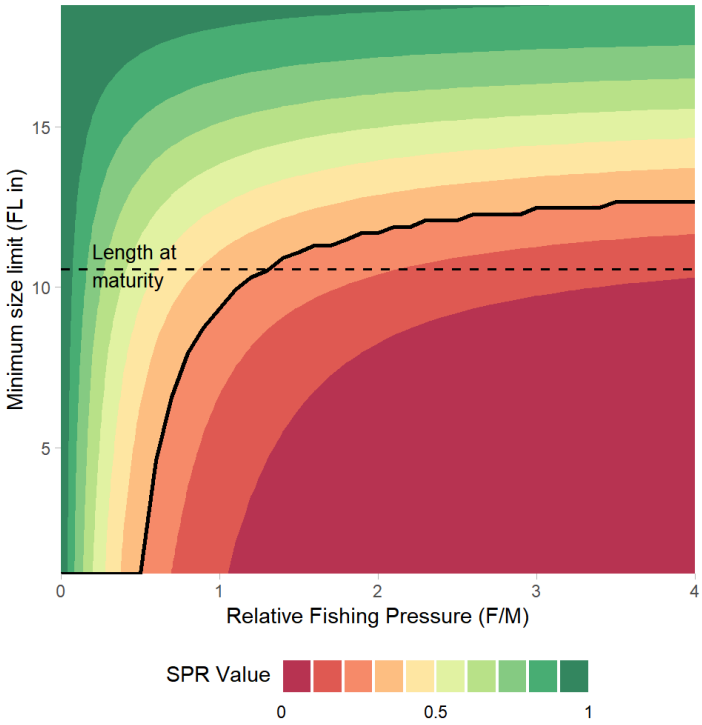
Cephalopholis argus - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	241	9.5	**0.76**	**0.86**	**0.89**
1 x Lm	268	10.6	**0.76**	**0.88**	**0.95**
1.1 x Lm	295	11.6	**0.74**	**0.89**	**1.00**
1.2 x Lm	322	12.7	**0.69**	**0.85**	**0.99**
1.3 x Lm	348	13.7	**0.62**	**0.79**	**0.94**
1.5 x Lm	402	15.8	**0.44**	**0.58**	**0.73**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Cephalopholis argus

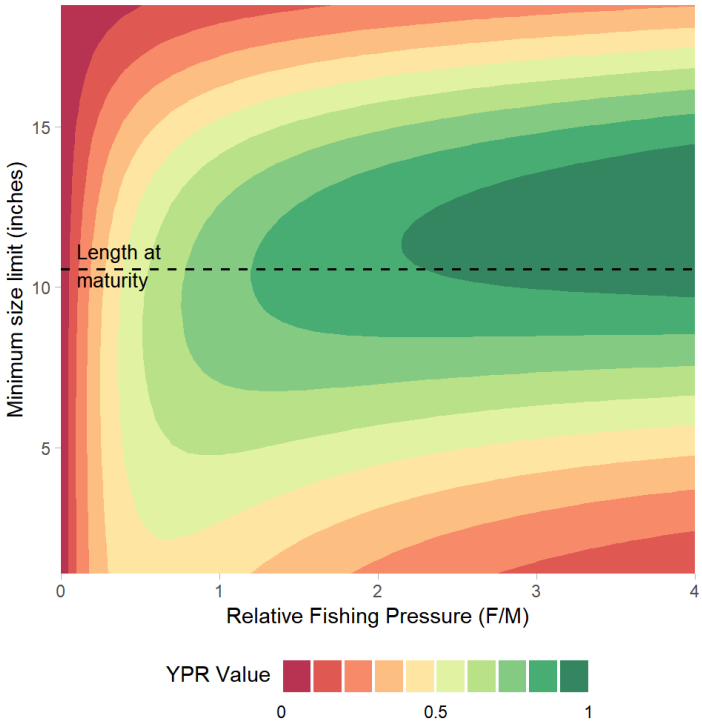
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Cephalopholis argus

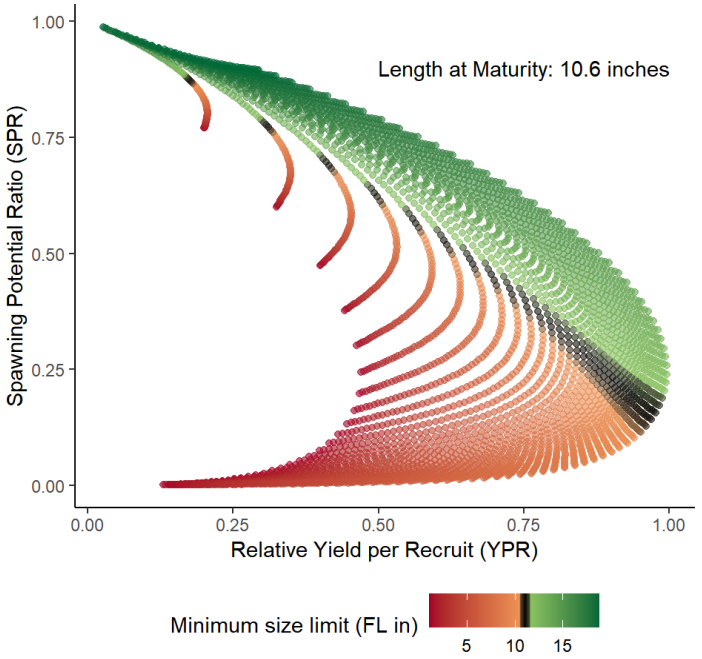
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Cephalopholis argus

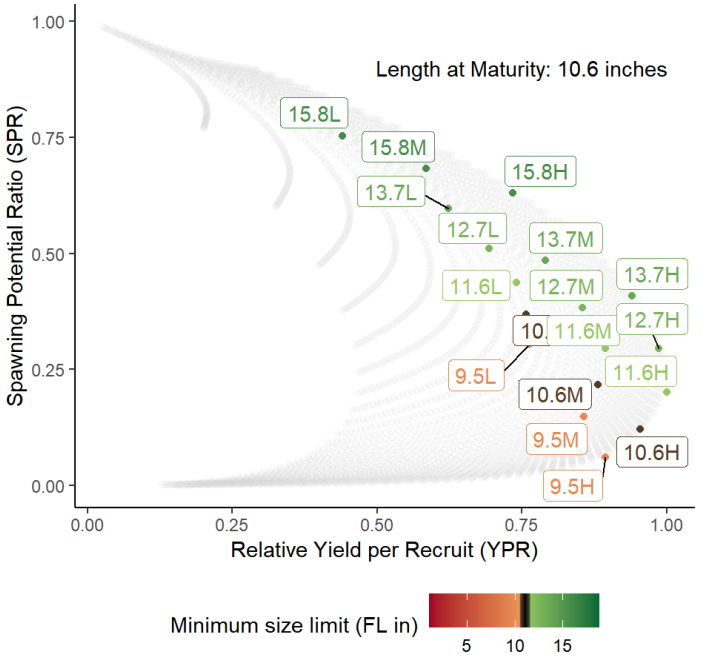
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Cephalopholis argus

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).

Sphyraenidae - Barracudas

Species: **Sphyraena barracuda**

Hawaiian Name: Kaku

Common Name: Great Barracuda

Family: Barracudas

Current Minimum Size Limit (FL): NA

Life History Parameters

Loo (von Bertalanffy asymtotic size): 1236 mm FL

K (von Bertalanffy growth parameter): 0.26 per year

t0 (von Bertalanffy parameter): -0.71

Lm (Length at maturity): 780 mm FL

Lm (Length at maturity): 31 inches FL

M (natural mortality rate): 0.17 per year

Longevity: 19 years

M/K: 0.65

Lm/Loo: 0.63

Sphyraena barracuda - SPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	702	27.6	**0.36**	**0.19**	**0.08**
1 x Lm	780	30.7	**0.40**	**0.23**	**0.12**
1.1 x Lm	858	33.8	**0.44**	**0.29**	**0.18**
1.2 x Lm	936	36.9	**0.50**	**0.36**	**0.25**
1.3 x Lm	1014	39.9	**0.58**	**0.45**	**0.36**
1.5 x Lm	1170	46.1	**0.78**	**0.71**	**0.65**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

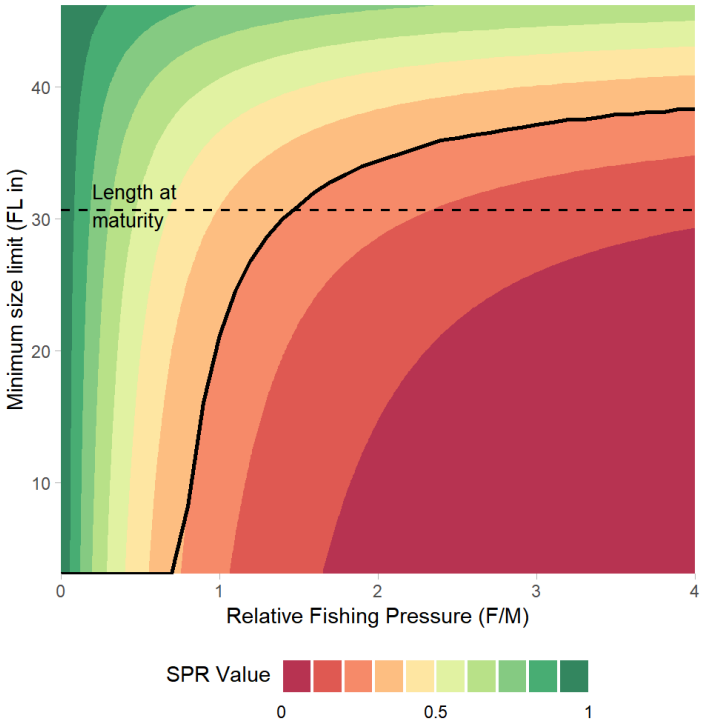
Sphyraena barracuda - YPR Values

Minimum Size Limit			Fishing Pressure (F/M)		
Option	**mm**	**inches**	**Low**	**Med**	**High**
0.9 x Lm	702	27.6	**0.77**	**0.85**	**0.83**
1 x Lm	780	30.7	**0.78**	**0.90**	**0.92**
1.1 x Lm	858	33.8	**0.77**	**0.92**	**0.97**
1.2 x Lm	936	36.9	**0.74**	**0.91**	**1.00**
1.3 x Lm	1014	39.9	**0.68**	**0.85**	**0.98**
1.5 x Lm	1170	46.1	**0.41**	**0.54**	**0.67**

Note:
Option refers to minimum size limit specified as a multiple of length at maturity (Lm). Current size limit (where applicable) is current DAR regulation.

Sphyraena barracuda

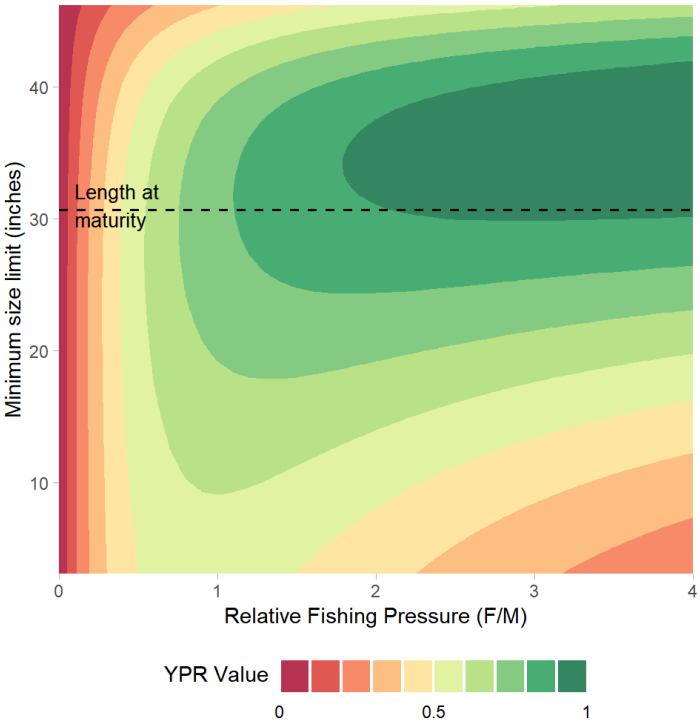
SPR Values



Note:
SPR plotted across combinations of minimum size limit and fishing pressure. Solid line corresponds to minimum size limit - F/M combinations that achieve 30% SPR. Labels correspond to SPR achieved for minimum size limit - F/M combinations presented in table above.

Sphyraena barracuda

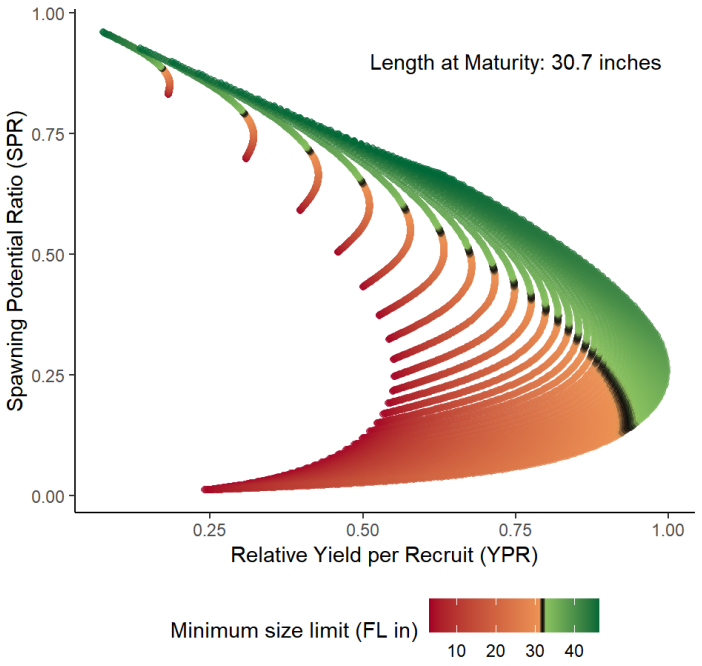
YPR Values



Note:
YPR plotted across combinations of minimum size limit and fishing pressure. Labels correspond to YPR achieved for minimum size limit - F/M combinations presented in table above.

Sphyraena barracuda

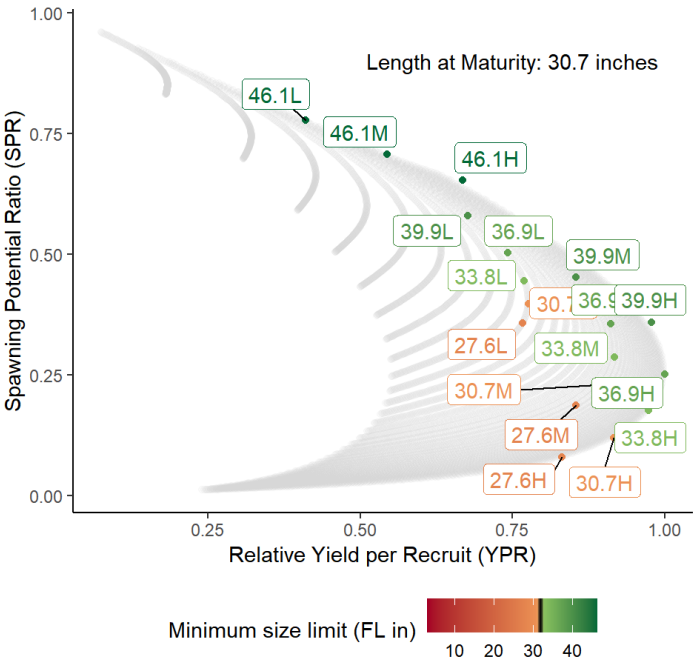
SPR-YPR tradeoffs



Note:
All size limit and fishing pressure combinations plotted. Color gradient indicates minimum size limit, with black points corresponding to minimum size limit set equal to species' length at maturity. Green points are minimum size limits greater than species length at maturity.

Sphyraena barracuda

SPR-YPR tradeoffs, highlighting options from tables above.



Note:
All size limit and fishing pressure combinations plotted in light grey. Labels contain information on combination of minimum size limit in inches (numbers) and fishing pressure (letters: L = low, M = medium, H = high).